SUPPLEMENT

TO THE

BRITISH MEDICAL JOURNAL.

LONDON, SATURDAY, JULY 3RD, 1926.

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British Medical Association.

SCIENCE COMMITTEE:

REPORT OF SPECIAL SUBCOMMITTEE ON RHEUMATIC HEART DISEASE IN CHILDREN.

INTRODUCTORY NOTE.

IN January, 1924, the Science Committee of the British Medical Association, acting in circumstances detailed in the Report printed below, appointed a Special Subcommittee of Inquiry into Heart Disease in Children, consisting of the following physicians:

SIR HUMPHRY ROLLESTON, BART. (*Chairman*).

DR. GEO. A. ALLAN. DR. F. J. POYNTON.

DR. CAREY F. COOMBS. DR. A. P. THOMSON.

DR. REGINALD MILLER (*Honorary Secretary*).

Sir THOMAS LEWIS gave valuable assistance by attending the meetings of the Subcommittee at the invitation of the Chairman.

The Report of the Subcommittee on Rheumatic Heart Disease in Children has now been received by the Science Committee. It consists of a Preface summarizing the views, and detailing the proposals, of the Subcommittee, and signed by the Chairman on its behalf. This is followed by four Reports. The opinions expressed in the Preface are based on these Reports, which are written by the individual members of the Subcommittee whose names appear above.

The Report should prove of very great value to the profession. Probably attention will be particularly directed to its proposals in connexion with an aspect of the problem which has hitherto received too little

notice—namely, the organization of the effort now needed for prevention and after-care in this disease. At a later date the Council will doubtless indicate the steps it will be proper for the Association to take to bring the Report to the notice of public authorities and others interested in the prevention and treatment of rheumatism in children, in the hope of helping to limit the prevalence of heart disease, which is responsible for so many deaths, so many maimed lives, and such an immense economic loss to the country.

The work entailed in the production of the Report has extended over a period of two and a half years. The thanks of the Association are due to those who have devoted so much time and thought to a subject which is one of the main outstanding problems awaiting solution by the medical profession of this country.

REPORT OF SUBCOMMITTEE OF INQUIRY INTO RHEUMATIC HEART DISEASE IN CHILDREN.

PREFACE.

To the Science Committee of the British Medical Association.

GENTLEMEN,

Your Subcommittee, in presenting this Report, ventures to remind you of the circumstances of its appointment.

At the Annual Meeting of the British Medical Association at Portsmouth, held in 1923, a discussion on "The Etiology and Treatment of Heart Disease in Early Life," in the Section of Medicine, was opened by Dr. Reginald Miller. At the end of this discussion the meeting, on the motion of Dr. G. A. Allan, resolved:

> "That the Council of the Association be recommended to appoint a special committee to consider the best steps to be taken to combat the grave menace to the community arising from cardiac diseases."

In October, 1923, this resolution was referred to you by the Council of the Association, and in January, 1924, the Subcommittee now furnishing its report was appointed by you, with the following reference:

> "To inquire into the steps which have been, and are being, taken in relation to the prevention, detection, and treatment of cardiac disease in children, and to make proposals in connexion therewith."

This Subcommittee, consisting of physicians directly and constantly in touch with the problems under consideration, at its first meeting decided to limit its definition of "cardiac disease in children" to cardiac rheumatism, and to divide its inquiry into two main parts—prevention and treatment.

Prevention.—As it appeared that little or nothing had been done to prevent rheumatic infection in childhood, a first step was to see what immediate practical policy could be proposed. This brought up the question: Is the knowledge of the etiology of this disease sufficient to furnish the basis for a plan of prevention? To answer this question two separate reports were required—one on the environmental factors predisposing to rheumatic infection, and the other on the bacteriological aspects of the disease.

Treatment.—Among the various lines of inquiry that were considered by the Subcommittee, two appeared to be of urgent importance—the first, the value of tonsillectomy as a means of limiting the injuries inflicted by rheumatic infection; the second, the present position for after-care of rheumatic children. The terms of the resolution arranging this division of labour were:

> "That the Subcommittee proceed with investigations on the lines indicated below, and that the persons named be asked to draw up reports in connexion with their respective investigations and submit them to the next meeting, it being understood that all members of the Subcommittee will assist in the collection of information, and in any other way, which will help towards the preparation of the four Reports."

1. Report on the Environmental and Other Predisposing Causes of Rheumatic Infection.
   Dr. REGINALD MILLER.
2. Report on Recent Investigations into the Bacteriology of the Rheumatic Infection.
   Dr. CAREY COOMBS and Dr. F. J. POYNTON.
3. Report on the Effect of Tonsillectomy on Rheumatic Infection in Children.
   Dr. REGINALD MILLER.
4. Report on the Organized After-Care of Rheumatic Children in Great Britain.
   Dr. GEO. A. ALLAN with Dr. A. P. THOMSON.

SUMMARY OF REPORTS.

In the following summaries it will be noted that in two of the Reports (Nos. 1 and 3) the Subcommittee has not only reviewed the present position, but has also pursued investigations yielding results now published for the first time.

I. ON ENVIRONMENTAL AND OTHER PREDISPOSING CAUSES.

In addition to confirming the importance of the sociological factor, this report furnishes substantial support to the view expressed by its author at the Portsmouth meeting of the British Medical Association

PART I.

REPORT ON THE ENVIRONMENTAL AND OTHER PREDISPOSING CAUSES OF RHEUMATIC INFECTION.

BY

REGINALD MILLER, M.D., F.R.C.P.,

LONDON.

THE briefest study of the causes predisposing to rheumatic infection is enough to discover the multiplicity of the factors at work and the comparative lack of precise information available about them. Certain impressions have been accepted which are probably quite correct, but they are backed by little in the way of quotable statistics or definite evidence. Probably it is true to say that, until quite recently, the rheumatic infection has received less attention from the public health point of view than any other disease so prevalent and so harmful.

In view of the number of factors at work in producing the rheumatic infection of children it is clear that no single one can be found to outweigh the others, but certain of them, established beyond criticism, are of such outstanding importance that it is well that they should be enumerated at once although they may require mention again later.

1. *Climate.*—The importance of this as a general predisposing cause of rheumatism is shown by the special prevalence of the disease in countries within the temperate zone, and by its definite seasonal (October to March) incidence in England.

2. *Age.*—The influence of the age of the patient is well recognized. The disease is essentially one of school years, the first attacks of the severer types occurring most commonly about the seventh or eighth year of life.

3. *Social Status.*—Although technically the rheumatic infection may not be a "poverty disease" in that its frequency does not seem to follow absolutely the variations in degrees of poverty, yet nothing is more certain than that it is a disease of the poorer classes. In London it is almost entirely a disease of hospital as opposed to private practice—far more so than is, for instance, pulmonary tuberculosis. This is so definitely a fact that if the problem of the predisposing causes of rheumatism is ever to be settled it will require explanation. If we knew why the infection is so common in the elementary schools of the State and so rare in the private preparatory schools or the public schools of the richer classes, we should have gained a key position in our fight against the disease. Clearly this is a matter for the public health worker rather than for the practising physician.

4. *Tonsillar Infection.*—It is universally recognized that the portal of entry of the infecting organism is, in the majority of cases, through the nasopharynx in general and the tonsils in particular. This proportion is at its highest when only first attacks of rheumatism are considered and cases of pure chorea are omitted (see Report on the Effect of Tonsillectomy). So close is the association between rheumatism and tonsillar infection that we can only conclude that such environmental factors as predispose towards chronic tonsillitis must be of importance as predisposing towards rheumatic infection. To these factors some would add that of hereditary influence, but in my opinion the potency of this factor is not so distinct or clear-cut as those already mentioned, and its consideration is deferred until later.

WORLD DISTRIBUTION.

That rheumatism is particularly a disease of temperate climes was shown by Church's[3] laborious investigations published in 1897. He showed, however, that its prevalence throughout the world was more widespread than had been thought. There has been no recent inquiry into this question, and material for any accurate world-map of rheumatism is probably not available.

A comparison of the incidence of the disease in the various countries of the temperate zone could probably be worked out with less labour and greater accuracy, but that it would be of much practical value is doubtful. It seems unlikely that any country would show a higher incidence than Great Britain, and it is impossible to escape the conclusion that we have here enough material in a sufficiently large area to give all the information necessary, were it properly investigated.

BRITISH PREVALENCE.

Coming to the question why rheumatic infection is so prevalent in Great Britain several points require notice.

1. *Racial Predisposition.*—There seems no clear evidence that the infection follows a racial distribution except in so far as that coincides with its geographical distribution. Shrubsall[19] and Mackintosh[10] have suggested that the disease is commoner in the English of Nordic ancestry (blondes) than in those of Iberian descent.

2. *Climate.*—It is impossible not to accept the tradition that rheumatism flourishes in a climate preponderatingly damp and cold, and that our own notorious climate is an important factor in increasing the prevalence of the disease in this country. This view receives strong support from the well attested fact that it is here, as Newsholme[15] found to be the case in Scandinavian countries, a disease of the colder and wetter six months of the year. Coombs[6] found that the rheumatic death rate in Bristol showed the same seasonal curve, an interesting confirmation of the important clinical fact that a cardiac breakdown means fresh rheumatic activity. The climatic factor in the production of rheumatism in this country cannot possibly be without great importance.

3. *Island Situation.*—It might seem that, an island being exposed to damp atmospheres, this might be one reason for the high incidence of rheumatism here. It is difficult to separate this factor from the general one of climate, but taken alone it would not appear to be of very great importance, as is shown by the rarity of the disease in the Channel Islands[9] and, I am told, in the Scilly Isles. In the Isle of Man the incidence is high (Church).

4. *Urbanization.*—England will of necessity suffer if urbanization and industrialization are factors predisposing towards rheumatism. Evidence supporting this view will be given later.

BRITISH DISTRIBUTION.

1. *Rheumatic Map of Great Britain.*

Up to the present no really satisfactory map of England, showing the rheumatic distribution, has been constructed. No figures published enable this to be done. The infection is nowhere notifiable, and the Registrar-General's returns do not separate deaths from rheumatic heart disease from those from other types of heart disease.

The most recent attempt to construct such a map was made by Young[22] in 1921. His results largely contradict those obtained by Haviland in 1875. Young studied the distribution of the mortality from rheumatic fever in the registration counties of England and Wales as shown by the standardized death rates from age 15 upwards for the decennium 1901-10. This method he stated in 1925 gave the only criterion available at present. He found that the higher incidences occurred in general in the northern and western counties. Again, in 1925,[23] he examined the distribution of deaths from heart disease from age 25 and upwards. This distribution roughly corresponded with the former—that is, with the wetter and colder parts of England.

in 1923, that a child is predisposed to rheumatic infection if he grows up in a damp dwelling. This conclusion is given particular prominence because of its immediate practical bearing. Further inquiry is recommended into housing conditions and into the general question of geographical distribution. It is also suggested that accurate information concerning the intestinal flora of the rheumatic child would be worth collecting.

II. On the Bacteriology of Rheumatic Infection.

The report shows that while the recent growth of our bacteriological knowledge of this disease has been but slow, it has been in favour of the streptococcic hypothesis. There is, however, much knowledge yet to be gained concerning the pathogenesis of the infection. To assist such inquiries it is highly desirable that material for investigation should, as far as possible, be pooled.

III. On the Effect of Tonsillectomy.

This subject is full of difficulty. The Subcommittee's inquiry, however, suggests that in the child whose tonsils have been completely removed a milder type of rheumatic infection, in which the cardiac lesions are relatively light, is likely to be seen. The report therefore furnishes evidence in favour of tonsillectomy, but the Subcommittee, realizing the wide variation of the conditions under which the operation is performed, deems it premature to recommend its routine performance.

IV. On the Provision for After-Care of Rheumatic Children.

From the information received it is clear that the need of rheumatic children for prolonged care is as yet imperfectly realized in the country as a whole. Here and there adequate institutional accommodation is being planned, but for the most part the urgent need for this means of treatment is not recognized. The Subcommittee, therefore, wishes to insist that it is necessary for every large city to be provided with the means for the institutional treatment of rheumatic children in the course of which they can receive controlled rest, with plentiful sunlight and fresh air, concurrently with education, over periods of months.

PROPOSALS.

The policy advised by the Subcommittee, therefore, consists of:

1. Stricter attention to the prevention of damp in dwelling-houses.
2. Further investigation of housing conditions and of the geographical distribution of the disease.
3. Pooling of material for investigation of the bacteriological aspects of rheumatic infection in childhood.
4. Careful and discriminating use of the operation of tonsillectomy.
5. Rapid expansion of the accommodation available for prolonged institutional care of rheumatic children.

The Subcommittee is indebted for assistance in the collection and arrangement of material for this Report to:

Dr. G. A. Auden, School Medical Officer, Birmingham;
Dr. Vincent Coates, Bath;
Dr. Mary Davies, London;
Dr. C. E. K. Herapath, Bristol;
Dr. John Morrison, Assistant School Medical Officer, Bristol;
Sir John Robertson, M.O.H. Birmingham;
Dr. Maud Sanderson, London;
Dr. R. E. Thomas, School Medical Officer, Bath;
and
The Paddington and Kilburn Committee of the Invalid Children's Aid Association.

Finally, the warm thanks of the Subcommittee are due to Dr. Reginald Miller, its Honorary Secretary, for his enthusiasm, devotion, and driving power in the conduct and construction of this Report.

Signed on behalf of the Subcommittee,

HUMPHRY ROLLESTON.

in 14 more. The same authors, in investigations specially undertaken for this report,[5] found in 32 cases a strong family history in 12. Morrison,[14] also in special investigations made in Bristol for this report, found a definite hereditary taint in 26 out of 54 cases, and a weak history in 4 more instances.

Figures such as these cannot be ignored, but it is difficult to know precisely what importance to lay upon the hereditary factor. In the first place, rheumatism is a very common disease, and it is concentrated in the families of the poorer classes; thus in any case it is bound to appear frequently in the families of rheumatic children. Again, if strictly environmental causes are of great importance, it must be remembered that in most instances they will operate alike on the family and the patient.

The point at issue is this: Does the hereditary and family tendency swamp the environmental factors at work in producing the disease? Taken at their face value, the figures quoted above might suggest that this is so, but I doubt if they justify a conclusion more definite than that perhaps the hereditary influence aids and abets the environmental influence.

I have often observed—a point that Thomson[20] has stressed—that there is also a family history of tuberculosis in rheumatic cases. Thomson found that in a series of cases at Birmingham a family history of rheumatism was present in 25 per cent. of the cases, and a tuberculous taint in the family in the same proportion. Tuberculosis, again, is a common disease, and this association probably means no more than that both infections are frequent where the general invalidity rate is high. It remains a curious point that, although it is not uncommon to find a family containing both tuberculous and rheumatic children, it is, in my experience, extremely rare to find active tuberculosis in a rheumatic child.

2. *Direct Contagion.*

All the evidence points against the importance of this factor, although everyone has from time to time seen two cases arising synchronously or close together in a family. Probably we should liken rheumatism in this respect to pneumonia or appendicitis rather than to tuberculosis. Of more interest are cases which seem to show a "house infection." I have seen severe rheumatism attack the children of three families occupying, one after the other, the same basement. The sequence is, however, of such rarity as to be more of academic interest than of practical importance.

3. *Housing Environment.*

Damp in Homes.—There is a traditional association between rheumatism and damp houses, and an attempt must here be made to see if this is well founded.

Before the war I had noticed[11] the frequency with which rheumatic children in the Paddington area of West London came from basements or from ground floors with no cellars underneath them. This experience was confirmed by the almoner's department at St. Mary's Hospital and by the workers of the local Invalid Children's Aid Association. Inspection of the homes showed that damp in the houses, often of the grossest kind, was frequent.

For this report three special sets of investigations have been made:

1. In West London, chiefly Paddington and St. Marylebone areas, 114 cases were investigated, 50 of them by myself; the others were vouched for by the local Invalid Children's Aid Association, with whom I work at both the hospitals with which I am connected.
2. At Bristol 52 cases were personally investigated by Dr. Morrison, school medical officer, working with Drs. Coombs and Herapath, who were responsible for diagnosing the cases.
3. At Bath 32 cases were investigated by Dr. V. Coates and Dr. R. E. Thomas.

In every case care was taken to ascertain the condition of the rooms actually occupied by the patient when first diagnosed as suffering from rheumatism. Cases starting where the housing condition could not be investigated have been discarded. In all the provincial and in most of the London cases, the homes were actually inspected. In addition, care was taken to ask questions as to whether clothes kept dry in cupboards, etc., with a view to finding out the real state of affairs and the difficulties experienced by the poor in dealing with damp.

The figures to be quoted in regard to the dampness of rheumatic homes may be taken to represent a minimum for three reasons. In the first place, it is not easy always to get a straight answer; the poor are apt to think that if they say their rooms are damp, blame will be imputed to them. Many times they have told me that their rooms are dry when all they mean is that they are dry as long as large fires are kept in them. Indeed, I rather gathered that this is their ideal of a dry home. Again, they fear that something will come to the ears of the individual whom they used to call "Sanitary," but whom it is now the fashion (with us in Paddington) to call "Town 'All." I am glad to be able to say that in several instances "Town Hall" had already been in and made improvements; but the poor are fearful of being dislodged. Secondly, these figures include many cases of chorea occurring as the only symptom of rheumatism, and I have a suspicion that in such cases housing conditions do not tell as much as in those of non-choreic rheumatism.[12] Thirdly, these cases include several instances of frank post-scarlatinal rheumatism.

Damp in Homes: Results of Investigations in 196 Cases.

	No. of Cases.	Rooms Damp.	Rooms Dry.
West London	114	76	38
Bristol...	52	30	22
Bath	30	16	14
Total	196	122	74

Taking, therefore, all cases investigated by several different people in three different localities, we find that 62.2 per cent. of rheumatic patients were living in damp houses when first attacked by the disease. My own series of fifty cases, included in the West London numbers given above, corresponded very closely to the total result. I found that 60 per cent. of my cases had been living in damp rooms when first attacked by rheumatism. Thomson,[20] investigating rheumatic cases in Birmingham, found that they came chiefly from the dampest parts of the town and that in 45 per cent. of their homes there were obvious signs of damp. His later figures raise this proportion to 52 per cent.: "this probably," he tells me, "underestimates the proportion of damp houses, for the visitors only reported dampness when they actually found it present on the occasion of their visit and did not record complaints from the inhabitants."

There is, then, abundant evidence to associate rheumatic infection with damp in the homes. Roughly, nearly two-thirds of rheumatic cases are first infected when living in damp rooms.

Position of Rooms in House.—As already mentioned, my attention was first drawn to the housing conditions in rheumatic patients by the frequency with which London cases appeared to come from basements. Going more fully into this point for this report the following figures were obtained. It should be mentioned that in the Paddington area the poor live chiefly in three-story houses, without basements; while some live in houses consisting of a basement with three stories above it.

Position of Rooms.

	No. of Cases.	Rooms Damp.	Rooms Dry.
Basement	12	10	2
Ground floor without basement or cellars under	12	12	0
Middle floor	6	1	5
Top floor	14	6	8
Whole house	6	1	5
Total	50	30	20

Subtracting the 6 cases inhabiting a whole house, 24 cases out of 44 (that is, 54.6 per cent.) were living either in basements or in ground-floor rooms with no cellars or

To be of practical value we need a rheumatic map based on a much smaller unit of detail than the county distribution of the disease. It is suggested that an opportunity of constructing such a map might now be available through the recruiting figures compiled during conscription. To take the proportion of rejections on account of valvular disease of the heart in each thousand recruits examined of ages 18 to 25 under conscription would give the rheumatic distribution with greater accuracy than anything we have had as yet. These figures must be in existence, but they do not appear to have been published. In the Report on the Physical Examination of Men of Military Age,[17] all ages are massed together in the figures published in Vol. I, which entirely spoils them for our purpose (Vol. II is not yet published). Peace-time recruiting statistics are published annually,[7] but these are not of value, as presumably many youths suffering from heart disease would know that they could not enlist in the army.

2. *Urbanization and Industrialization.*

It is very important that we should have more accurate information on the distribution of rheumatism in England, comparing rural and urban districts. It is generally agreed that, common as is the disease all over the country, it is specially a disease of towns, but we need much more accurate figures on this point before we can appreciate its importance to the full. Such statistics would show well in the recruiting figures under conscription already referred to.

(A) That the disease specially flourishes in towns can hardly be untrue as it is a view accepted by those most interested in the rheumatic problem. Certain scraps of evidence I have been able to find confirm this view.

Coombs[6] found, in investigating the rheumatic mortality rate in Bristol over a number of years, that each time the city was enlarged to include fresh rural areas the death rate fell. (Here, as in Young's map mentioned above, we have to assume that prevalence and mortality vary directly, a point which has been contested by some.)

Kennedy,[9] analysing recruiting figures for the army for 1901-10, found that "V.D.H." was "more prevalent in towns, especially in industrial towns." His figures varied from 1 per 1,000 in the Channel Islands to 32.4 per 1,000 in the East Riding of Yorkshire.

In the published recruiting report already mentioned[17] a note is made in the Welsh returns of the heavy incidence of "V.D.H." in the towns as compared with the rural areas. Examining only youths of 18 during conscription, it was found that rejections for "V.D.H." were 22 per 1,000 examinations in industrial Cardiff, and 2 per 1,000 in rural Carmarthen. More figures of this sort would be invaluable.

Some very important figures were published by Newman[1] in 1914. They were obtained from examinations of over 100,000 children leaving school, and divided into groups from industrial, residential, and rural areas. It will be seen that the increase in the incidence of heart disease in the children of industrial areas is more than can be accounted for by the increase in malnutrition or throat disease. His figures were as follows:

Percentage of Defective "Leavers."

	Industrial Areas.	Residential Towns.	Rural Areas.
Malnutrition	13.2	11.7	8.9
Disease of nose and throat	18.1	17.3	15.7
Disease of heart and circulation ...	8.0	5.9	2.6

There is no doubt, I think, that further investigation would fully confirm the view that rheumatic disease is a disease of towns in general, and industrial towns in particular.

(B) If this be accepted, there arises a most important question: Does rheumatic prevalence merely depend on a general rise of invadidity rate, or are there special causative factors operating in the poorer parts of towns which predispose specifically to rheumatic infection? To answer this question more information is needed; as, for instance, not only maps of rheumatism in counties but in cities.

That increased rheumatism rate will go with increased general sickness rate is obvious, in that it is a disease of the poorer classes and of towns as opposed to rural areas; but that a high incidence of rheumatism is only part of, and due to, a general high invalidity rate I do not believe will prove to be true. In this practically unexplored problem it is difficult to produce evidence in support of this conclusion, but two points may be mentioned:

(1) Rheumatism, as will be emphasized later, is a disease having a class incidence peculiar to itself; it is practically confined to the poorer classes, but notably is *not* a disease of the destitute slum-dweller. If a high invalidity rate were the only factor at work in increasing rheumatic prevalence, this, we may assume with some confidence, would not be the case.

(2) A study of the distribution of rheumatism in children in Birmingham made by A. P. Thomson produces important evidence—the first, I believe, of its kind. Based on some 400 cases, he writes to me: "Although it is true that the rheumatic areas lie in quarters of the city where poverty is general, a study of the map shows that they do not coincide; there are several poor regions which are relatively free from rheumatic infection."

3. *Rainfall.*

A certain amount of attention has been paid to this point, although it is doubtful if, in a country as damp as England, the variations in rainfall are of much moment.

(*a*) *District Annual Rainfall.*—If M. Young's results, quoted above, are accepted, it would appear that the disease is more prevalent in the wetter parts of the country. The seasonal incidence of the infection suggests that its prevalence is higher in the wetter months.

(*b*) *Seasonal Variations in Rainfall.*—Both Newsholme[15] and Coombs[6] have noted that spells of wet weather in summer seem to go with a later fall, rather than with a rise, in the incidence of rheumatism; while a persistently dry summer is associated with increased winter prevalence. These rather surprising results were contested by Church, and the arguments used are given in Newsholme's later paper[16] on the epidemiology of rheumatism. It is difficult not to agree with Church when he presses the winter incidence as an overwhelming argument against Newsholme's theories on the importance of the subsoil, dust, and flies in the causation of the disease.

4. *Altitude and Subsoil.*

The influence of these factors on the general distribution of rheumatism in England cannot be computed. They will be mentioned later in connexion with the influence of housing environment.

Individual Environment.

A question of the highest importance is now reached: Granted the predisposing causes operating on the country as a whole or on large districts of it, what are the factors at work in causing the individual child to become infected with rheumatism?

Before proceeding to discuss these factors seriatim there is a very important cause of difficulty to be mentioned: that of the possibility of labelling as *predisposing causes* what are really *early symptoms* of rheumatism. The disease rarely hits children severely with suddenness. On the contrary, in most cases a severe attack is preceded by weeks or months of vague ill health, not always easily recognized as due to rheumatism. Such symptoms as sore throats, intermittent muscular pains, pallor, shortness of breath, loss of appetite, a throat cough, general nervousness, irritability, tics, fidgetiness, headaches, emotionalism—these are, or may be, the invasion symptoms of rheumatism. Many factors can increase or unmask certain rheumatic symptoms though they cannot originate them.

1. *Heredity.*

Heredity as a factor predisposing to rheumatism has long been known and is generally accepted. Recent carefully collected figures may be quoted to show its frequency.

Coates and Thomas,[4] investigating 44 cases at Bath, found rheumatic fever or chorea in either parent, brother, or sister in 21 instances, and a more remote family history

catarrhal epidemics, leaving their harmful effects on the tonsils, must be vastly common amongst the children of the elementary schools. In this connexion may be mentioned the influence of scarlet fever epidemics. This is too well known as a precursor of rheumatism to need special emphasis.

(iii) *School Work and Stress.*—Work at school is often blamed by parents for the onset of chorea, usually without justice. On the other hand, I have too often seen it develop in the rheumatic child working for a competitive scholarship to set it altogether aside. Work is by no means the only strain on the nervous system of a rheumatic and neurotic child. Most children—and it is greatly to the credit of their teachers—are wonderfully happy at the London elementary schools, but one cannot help surmising that playtime must often be a greater source of fear to neurotic children than their working hours.

In connexion with all this it must ever be remembered that such harm can only be done to a child already rheumatic; it cannot give it the disease. The curious difficulty that teachers seem to find in recognizing early symptoms of chorea properly has been too often commented on by candid doctors to need more than bare mention here.

6. *Nutrition and Diet.*

That malnutrition predisposes towards rheumatic infection cannot be doubted, though its action, taken alone, is probably not a potent one. The figures given by Newman,[1] quoted above, in respect of the rural and urban school child, are of interest in this connexion. Further, it must be allowed that malnutrition may be a sign, and not a cause, of rheumatic infection.

An imperfect dietary has been held to be associated with the disease in a vague way for many years. The theory has undoubtedly lost ground since the infective origin of rheumatism has been universally accepted. Lately some careful observations by Vining,[21] working at Leeds, have called fresh attention to this aspect of the rheumatic problem. The connexion alleged between dietary and rheumatism may be discussed under three heads.

(i) Originally it was thought that there was some metabolic predisposition towards rheumatism in certain individuals or families. I find it difficult to rid my mind of a suspicion that this view was based on the association between diet and the rheumatic and gouty pains of elderly subjects. Applied to the definitely infective rheumatism of children, I see no room for the theory.

(ii) Of recent years the possibility of certain foods altering the micro-organisms of the intestine has become known, and although little has been written about it, the idea is probably in many minds that this may be a factor in rheumatism, especially in connexion with the recurrences, relapses, and smouldering infections of children. This is an interesting possibility, and more work is needed on this point before we can assess its value. In my own investigations I find that it is certainly true that some foods (notably London milk) will increase the streptococci in the stools, and that many rheumatic cases show such an increase, particularly, but not solely, those with diseased tonsils. The following results in eight consecutive rheumatic in-patients under my care may be detailed. Each case was taking an ordinary full mixed diet at the time of the examination of the stool.

Streptococci in Stools (8 Cases).

Faecal streptococci in normal proportion to *B. coli*:	
Tonsils removed, heart affected	2
Tonsils infected, heart unaffected	1
Faecal streptococci in greatly increased proportion:	
Tonsils normal, heart affected	1
Tonsils infected, heart affected...	2
Tonsils removed, heart affected...	1
Tonsils removed, heart normal	1

These details show how difficult it is at present to draw any conclusions associating an excess of streptococci in the stools with rheumatism in children, with or without tonsillar infection. Further, I have often found a great excess of streptococci in the stools of adults suffering from intestinal toxaemia, with or without oro-nasal infection.

However, there is certainly some sort of connexion between an excess of faecal streptococci and septic throats, intestinal indigestion and toxaemia, fibrositic pains, and colitis. It seems as though this might be a fruitful line of inquiry. Possibly such an excess of streptococci in the stools predisposes towards rheumatism, acting either as a direct infecting agent, or indirectly, by lowering resistance to streptococcal systemic infection, and hence inquiry along these lines may tend to fill that very important gap in our clinical knowledge—namely, the origin of rheumatic recrudescences and chronic infections in children.

(iii) Vining[21] has written very thoughtfully on association between rheumatism and diet, working through intestinal indigestion and debility. His paper is worth careful study. It may be said roughly (though it hardly does justice to the writer's care) that this represents the clinical side of the bacteriological conception already considered.

Conclusions.

1. There is in England enough rheumatism spread over a sufficiently large area to provide all the information required for the elucidation of the rheumatic problem; it is a more general study of the disease from the public health point of view that is wanted.

2. The disease in England is essentially one of children of the artisan class, living in damp rooms in an industrial town, attending an elementary school, and suffering from tonsillar sepsis.

3. Powerful predisposing factors are climate, age, social status, industrialization, damp dwellings, tonsillar infection.

4. Of the minor factors, attendance at school is probably the most important. The importance of heredity is more apparent than real; its frequency is largely a matter of home environment. In connexion with housing conditions, the proximity of the house to water, the subsoil, the altitude of the site, are of some importance as tending towards dampness in the home; but it is the state of the home, rather than its site, which is important. Nutrition and diet have not yet been proved to have a definite rheumatic predisposing power.

5. Conditions of great poverty, destitution, underfeeding, overcrowding, excessive dirtiness, do not seem to have an influence specifically towards rheumatic infection. Direct infection from one case to another is of no practical importance.

6. The key to the rheumatic problem would be in our hands if we knew why the disease in its definite forms is one of hospital as opposed to private practice. Why is the rheumatic scale always tipped against the children of the poor? Examining again the more important predisposing causes of rheumatism with this question only in mind, I submit the following points:

(*a*) *Tonsillar Disease.*—This is common enough in all classes, and will not explain the immunity of the well-to-do or the comparative immunity of the rural child. Its early recognition and treatment is doubtless a factor sparing the children of the richer classes.

(*b*) *Urbanization and Industrialization.*—Powerful factors as they are they do not explain the class distribution of the disease. There are areas in West London full of rheumatism within a mile of districts in which rheumatism is confined to the lesser side-streets and mews.

(*c*) *Poverty.*—This is an all-important factor, speaking generally, but it does not explain the whole question. Why are the poorest seemingly protected by their circumstances? What decides the distribution of the disease within the artisan class? It is not the financial condition of the affected family.

(*d*) *Damp Dwellings.*—In the special investigations undertaken for this report in London, Bristol, and Bath it is found that nearly two-thirds of rheumatic cases (including purely choreic and post-scarlatinal cases) come from damp rooms—an ample confirmation of the traditional association between rheumatism and damp. Is this the missing factor? Are the slum-dwellers protected by their overcrowding, living largely together in one room used as a kitchen? Are the rich protected by the comparative dryness of their homes, no matter the conditions of subsoil or altitude of site? Is the jerry-built house of an industrial town more at fault than the poky country cottage? Further work is needed before these questions can be finally answered, and it is urgently needed. It is curious

basements underneath them. The total series of 114 West London cases show much the same proportion. Subtracting 10 cases who occupied the whole of the house, 55 cases out of 104 (that is, 55.7 per cent.) came from basements or ground floors. The dampness of these floors was as follows: In the first series 22 out of 24 were damp; in the total series of 114 cases 51 out of 55 were damp. Analysing Paddington cases only, there were 63 cases, of whom 6 inhabited the entire house. Of the remaining 57 cases, 20 lived in basements and 13 in ground floors, making a total of 33 cases living "on the earth." Of these 33, damp was present in 30 instances.

It would therefore appear that to live in the dampest part of a house has some predisposing power towards rheumatic infection.

Proximity to Water.—In Paddington there are canals, and in St. Marylebone subterranean rivers, which Langmead[9a] has thought to influence rheumatic distribution in London. Thomson[20] found in Birmingham that "the great majority of the cases occurred along the southern banks of the two streams which flowed through the town." In this particular district the streets, he tells me, are periodically flooded. In Bath,[5] out of 29 cases, 21 lived near water. In Bristol,[14] out of 49 cases, 16 were found to live within 100 yards, and 8 more within 500 yards, of water.

Subsoil.—In the West London cases the soil is the usual London clay. In Bristol Morrison[14] specially investigated the subsoil in 28 cases, with the following result: river-bed 12, alluvial 7, lias 7, oolite 2. Coates and Thomas,[4] in 44 cases investigated at Bath, found: alluvial 13, gravel 15, lias 12, other types 4; and add the note that "the gravel in the majority of these cases is in an area adjacent to the river-bed and used to be flooded."

Altitude of Site.—The London cases come from low-lying areas with extremely few exceptions, but no particular stress can be laid on this fact as the two hospitals from which the cases come lie in the centre of such an area. In Bristol[14] out of 52 cases the site of the patient's house was found to be specially low-lying in 18 instances. In Bath[5] more accurate figures have been obtained in respect of 29 cases:

Altitude of House (Bath).

Below 100 ft. above sea-level	19 houses.
Between 100-200 ft.	8 ,,
Above 200 ft.	2 ,,

It would appear that the proximity to water, the subsoil, and the altitude of site, have all some predisposing power towards rheumatic infection, but it is very necessary that their importance should not be overemphasized. If there is anything in the connexion between damp homes and rheumatic infection, it is the dampness of the home itself which is primarily of importance. Its site is only of secondary importance as tending towards a damp home. That it is perfectly possible to live in a low-lying district close to water without the slightest fear of rheumatic infection is proved beyond criticism by the experience at Eton and Beaumont Colleges. Both these lie close to the Thames, and between them account for some 1,350 boys, and yet I am told by Dr. W. Attlee that he has seen only one case of rheumatic fever at Eton in seventeen years, and by Dr. L. O'Ferrall that he has met with no case at Beaumont during his eight years as medical officer to the school.

Other Housing Details.—Thomson[20] was unable to trace any direct influence on rheumatic prevalence from such factors as orientation of house, number of windows, type of ventilation. Coates and Thomas[4] also have investigated these points but draw no conclusions from them.

Summary.

It is clear that there is sufficient evidence to associate rheumatic infection with damp homes. The significance of this association cannot be discussed until the other environmental causative factors have been considered.

4. *Poverty.*

It has already been stated that in London acute rheumatism is practically confined to the poorer classes. There is no dispute about this fact. Hutchison[6] may be quoted as having recently confirmed this: "Rheumatism was certainly not specially a disease of the slum child, but he entirely agreed . . . that it was a disease of hospital and not of consulting practice, and he could count on the fingers of one hand the cases of acute rheumatic carditis that he had seen in consultation in the course of twenty-five years." Others confirm both the points here mentioned by Hutchison. Thomson[20] says: "Rheumatism is a disease of poor children, but on the whole it tends to be more frequent among the children of the decent poor than among the squalid." Coates and Thomas[4] in Bath say: "In practically every instance the parents of the affected children were in steady work, in receipt of a steady income, and generally belonged to the skilled artisan section of society." They give in the same paper the actual figures of family income per head, and for this report have furnished me with more examples showing the same fact.

The same fact is displayed in the following subheadings:

(i) *Overcrowding.*—Thomson[20] finds that overcrowding is not a factor in the production of chorea. Coates and Thomas[4] found overcrowding present in only 6 of 44 cases. The same is found in the special investigations made for this report at Bath and Bristol.

(ii) *Cleanliness.*—Coates and Thomas[5] found in 32 cases at Bath only 4 not clean in person or in house. At Bristol, Morrison[14] out of 55 cases found the child dirty in 5 instances, the house dirty in 13, and very dirty in 8 cases. That is, that out of 87 houses inspected 62 were found to be clean.

These facts demonstrate that rheumatism, although a disease of the poorer classes, is not one of the squalid slum child.

5. *School Environment.*

Certain facts which are known in connexion with rheumatism in school children may first be given.

(i) The disease is rife amongst the children of the elementary schools and practically unknown in its severer forms in those attending private day or boarding schools of the richer classes.

(ii) The disease often manifests itself for the first time in the years of school life. Thomas,[2] examining over 8,000 school children at Bath, found that the percentage of cases showing organic heart disease was for entrants 1 per cent. and for "leavers" 2.36 per cent. At Crewe rheumatism was found among entrants in 2.5 per cent., among "leavers" in 15 per cent.[2]

The school environment may be discussed under three headings:

(i) *Exposure.*—Any physician practising in London will realize the difference in the care that is taken to prevent the exposure of children to bad weather and colds in private day schools and the State elementary schools. In the first, careful arrangements for the changing or drying of wet clothes; in the second, with practically no exceptions, no such facilities. Again, in the case of the child attending the State schools there tends to be a rigidly enforced rule of attendance if physically fit, due to the fact that the school receives its grant based on the attendances, irrespective of whether any particular attendance will do the child good or harm. There is an unintelligent lack of elasticity in dealing with the irregular attendance of delicate children who are not "physically defective." The difficulties of the rural practitioner in this matter have been very candidly portrayed by Noy Scott.[18] However unsatisfactory all this may be, one must not overestimate the harm that is done by such exposure. Two facts show that it is not the main factor which causes rheumatism to be so prevalent amongst the poor; if it were, the disease would be less common in urban districts where the schools are near at hand than in the rural districts where the schools are frequently as much as three miles distant from the children's homes; and, again, it would be more common among the very poorest who are least protected by clothing than among the artisan type of families. In this connexion may be noted the comparative freedom from acute rheumatism of the British troops in Flanders during the war.

(ii) *Epidemics.*—In guarding against epidemics there is again a vast difference between the circumstances of State and private education. One can only imagine that

APPENDIX TO PART I.

FORM OF QUESTIONS ISSUED BY THE SUBCOMMITTEE.

RHEUMATIC ENVIRONMENT IN CHILDREN.

Case Sheet.

(Please see NOTE.)

Name..... Sex..... Age .....

Address .....

1. PERSONAL.

PRESENT ATTACK.
First or later?.....
Onset of preliminary symptoms: year.....month.....type.....
Date of first attendance for present symptoms: year.....month.....
Symptoms: Tonsillitis,.....fever,.....pains,.....arthritis,.....
heart,.....chorea,.....nodules,.....
Tonsils: Previous tonsillitis.....since when.....often.....
previously removed,.....when,.....by whom.....
completely removed?.....
Cause of present attack:
Attributed by parent,.....
Other possible causes,.....
Previous illness possibly contributing,.....
.....
.....
date,.....
Treatment received for these factors:
What treatment.....
.....
.....
When.....Where.....
.....
FIRST ATTACK. Address,.....
.....
Earliest symptoms: year,.....month,.....type,.....
First real attack: year,.....month,.....type,.....
Possible cause: .....

2. FAMILY.

No. of children born,.....place in family,.....No. now living,.....
Any others ill at the same time as patient?.....
Present attack?.....What illness?.....
Previous attacks?.....What illness?.....
Any acute rheumatism in family?.....
Details.....
.....
.....
Frequency of "colds" in family,.....
Any other diseases in family.....tuberculosis?.....
Details.....
.....
.....

3. HOME ENVIRONMENT.

Father's work.....Mother out to work?.....
Father in regular work.* Irregular.* Out of work.*
Poverty: Poor.* Very Poor.* Destitute.*
Cleanliness: Patient?.....Parents.....
No. of Rooms.....No. of Occupants.....
Living Rooms: No.....Basement.....Other Floors.....
If ground floor, any cellars under?.....
Sleeping Rooms: No.....Basement.....Other Floors.....

4. SCHOOL ENVIRONMENT.

What School.....Attendance regular?.....
Fraction absent?.....
Distance from School: Time?.....Miles?.....
Protection from weather:
Conveyance.....Clothing.....Boots.....
Drying facilities at School,.....

5. REPORT ON HOUSE.

Did patient's first attack occur here?.....Later attacks { also* / only* }
Condition of House: .....
.....
.....
Damp.....
Details.....
Do clothes, etc., kept in cupboards get damp?.....
Sunshine: Living rooms.....Patient's sleeping room.....
Dirt.....
Age and general repair of premises.....
.....
.....

6. REPORT ON LOCALITY.

.....
.....
.....
Specially Low-lying?.....High-lying?.....
Near Water: River.....Canal.....Reservoir.....
.....
.....
.....

7. SUMMARY.

General impression of etiological factors in this case:
.....
.....
.....
Any ONE special factor to which illness seems most attributable:
.....
.....
.....

Signed.....

NOTE.

Many answers can be given as "yes" or "no," or as "+" or "–." Where a definite negative is intended the space should not be left blank but "no" or "–" should be inserted. A space left blank should only indicate "no information."

Special attention is drawn to the importance of investigating FIRST attacks.

(*a*) Where a later attack is being investigated, space is provided for information on the first attack at the bottom of page 1.

(*b*) Space is provided for tracing the very earliest preliminary symptoms for both first and later attacks.

* Strike out words inapplicable.

that this is the first study of the housing conditions of rheumatic patients which has been undertaken on anything like a large scale.

7. There is no other infective disease, not in itself infectious, which shows the same curious class incidence as rheumatism. I believe myself that further investigation, carefully conducted on definite cases only, will show that the damp home is one of the most important predisposing environmental causes of rheumatism and heart disease in children, and that the damp house does not predispose towards rheumatism merely by increasing the general invalidity rate, but has a more direct influence on the production of rheumatism itself.

Matters calling for further Investigation.

Further work seems to be particularly needed along the following lines:

1. More accurate knowledge of the distribution of rheumatic cases in England, more particularly with regard to its incidence in rural, residential, and industrial areas respectively, and the relationship between high rheumatic prevalence and increased general invalidity rate. Thus certain specific rheumatic factors might be displayed. It is suggested that more accurate information on these points than has yet been available might be obtained from the hitherto unpublished recruiting-rejection returns under conscription for the different districts, especially from the study of the occurrence of "V.D.H." in the youths of 18 called up towards the end of the war. Similarly, rheumatic maps of towns and cities are needed to study further the connexion between rheumatic and poor areas. Where they do not coincide, the added factors might be shown. The relationship between rheumatic incidence and general sickness rate should be studied in the same way.

2. Further investigation into the housing conditions of rheumatic subjects. It is suggested that this might be undertaken by making acute rheumatism notifiable in certain districts, or, better, by the voluntary notification of it by hospital physicians interested, working in conjunction with medical officers of health and school medical officers. While we are still only in the stage of investigation, the chief thing to be avoided is the wholesale notification of thousands of cases which cannot be properly investigated.

3. Further research into the question of the streptococcal content of the stools of rheumatic and other children, and the relation between the intestinal flora, tonsillitis, tonsillectomy, diet, acute rheumatic attacks, relapses and recrudescences, and smouldering rheumatic infections.

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PART II.

REPORT ON RECENT INVESTIGATIONS INTO THE BACTERIOLOGY OF THE RHEUMATIC INFECTION.

BY

CAREY F. COOMBS, M.D., F.R.C.P., AND F. J. POYNTON, M.D., F.R.C.P.

IN 1906 Bulloch[1] summed up a review of the subject as it stood at that date by saying that

"it cannot be held that the *Micrococcus rheumaticus* is the cause of rheumatic fever, as it does not fulfil all or indeed any of Koch's postulates. It is not found in every case of the disease, and the effects which it produces experimentally do not differ essentially from those produced by cocci which have been isolated from cases having nothing to do with rheumatic fever. In spite of the numerous investigations which have been carried out, it seems to me that the etiology of rheumatic fever still belongs to the arcana of pathology, and although what clinicians call rheumatic fever is probably a specific infective disease, the virus is not known."

In the same year L. A. Conner[2] concluded a report to the American Medical Association thus:

"(1) Acute rheumatism is a specific infection not merely an attenuated pyaemia; (2) the bacillus of Achalme has no etiological significance; (3) while there is much evidence in favour of the streptococcus theory, yet positive proofs of the specificity and identity of this organism, and of its causal relation to rheumatism, are still lacking."

These reports are fairly representative of the opinion of the days in which they were drawn up. Bulloch's view was doubtless influenced by his own failure to recover any micro-organism from a careful search of rheumatic material, but other bacteriologists had been equally unfortunate, and the British attitude towards the streptococcus theory of rheumatism remained more cautious than that of America.

It is our duty to review the evidence that has been collected since these reports were drawn up. In the first place, Conner's verdict as to the Achalme bacillus has been confirmed by subsequent workers. Up till the outbreak of war its claims were supported by several French bacteriologists, notably by Rosenthal.[3] But in 1913, Bosc and Carrieu[4] having criticized its claims on the ground that it is to be found on the skin of animals, and of normal as well as rheumatic human subjects—in other words, that it is a contamination—Achalme[5] in his reply admitted its similarity to, if not identity with, *B. perfringens*, *B. enteritidis sporogenes*, etc. There has been no new evidence in favour of this organism apart from that furnished by the alleged value of vaccines prepared from it in the treatment of acute and chronic rheumatic myocarditis (Lautier[6]).

The other suggestion discounted by Conner in his report, that of the Vienna school which treats acute rheumatism as an "attenuated pyaemia"—that is, an infection of the blood by all sorts and conditions of organisms—has had no support that we can find since 1914. In that year Wiesel[7] gave a long summary of the evidence in favour of this view, that rheumatism is the expression of any bacteriaemia acting on constitutionally predisposed subjects; and Singer,[8] the author of the theory, also repeated it, with a rider to the effect that though any coccus might cause rheumatism it was usually a streptococcus.

The difficulty of growing any micro-organism from the fluids and tissues of rheumatic subjects has prompted the suggestion that it is an ultramicroscopic or filterable virus. Recent work done by Miller[9] with Andrewes,[10] and Andrewes and Swift[11] does not lend support to this. From the fluids and tissues of 16 patients with acute rheumatism suspensions were made, and many animals inoculated therewith, but without any result. Intracellular bodies that were at first thought to be pathogenic were found, but subsequent inquiry identified this with a virus probably "normal" in rabbits.

The failure of the streptococcic hypothesis to secure general support is therefore not due to the force of any alternative claim. There are, however, reasons for this failure, which must now be examined.

I. Many investigations have failed, as Bulloch's did, to find any organism whatever. The most recent of these is Thayer's,[12] whose fellow workers looked for an infective agent in 19 cases of acute rheumatic carditis, but without any success. Other notable failures were those of Harrison,[13] who examined, without result, 26 cases of acute rheumatism; and Bosc and Carrieu,[14] who got nothing out of 12 cases. On the other hand, a good many workers have found streptococci in rheumatic lesions. Beattie,[15] continuing work which falls chiefly into the period covered by Bulloch's and Conner's reports, grew a streptococcus from the synovial membrane of a rheumatic joint. Rosenow[16] recovered a streptococcus from 7 out of 8 cases of early acute rheumatism. Loeb[17] also grew a streptococcus from the blood in 7 out of 45 cases of acute rheumatism examined by him, from the blood of one case of chorea, and from the joint fluid of one case of acute rheumatism. Richards[18] recovered a small streptococcus forming green pigment on blood-agar plates from the blood of two patients with chorea. Lintz[19] grew a Gram-positive diplo-streptococcus from the blood of 4 out of a large number of cases of acute rheumatism. Costa[20] isolated a Gram-negative streptococcus once from a subcutaneous rheumatic node and twice from a monarticular arthritis. Irish,[21] in 3 out of 6 subcutaneous nodes examined, found a streptococcus tending to form pairs. Butterfield[22] described Gram-positive diplococci with a tendency to short-chain formation found in a case of acute rheumatism. Wachter[23] grew streptococci from the heart's blood of several fatal cases of acute rheumatism. Camisa[24] grew a diplo-streptococcus from the blood in 6 out of 9 cases of chorea investigated. La Fetra[25] recorded the recovery of *Streptococcus viridans* from 2 out of a number of cases of chorea examined at the Bellevue Hospital, New York; though at the same discussion it was stated that similar attempts at the Mount Sinai Hospital had been fruitless. Quigley,[26] examining 21 cases of chorea, got streptococci from the blood in 10 and from the cerebro-spinal fluid in 13. In a majority it was a small coccus, similar to one recovered from a minority of the tonsils examined from the same cases. Clawson[27] has recently described streptococci derived from 20 cases of acute rheumatism (the number of failures is not stated). This organism tended to grow on its first culture in lance-shaped pairs. Its sugar reactions were like those of *S. faecalis*. We have each of us[28 29] recorded the fact that we have seen various reliable bacteriologists grow diplo-streptococci from the fluids and tissues of rheumatic patients. Finally, there are two investigations carried out on a larger scale to which we must draw particular attention. Herry[30] made examinations of material from 60 patients suffering from acute rheumatism, blood and tissue fluids for the most part, with *post-mortem* material from a few cases, and from 50 of these was able to recover a micrococcus growing in pairs or short chains. It was Gram-positive, formed much acid, and grew both aerobically and anaerobically. Swift and Kinsella[31] examined 58 patients. All their joint cultures were negative, but from 6 of their blood cultures they recovered a streptococcus which they regarded as identical with *S. viridans*. It was more virulent, however, than those of the normal mouth and those associated with endocarditis lenta, while less so than the haemolytic streptococci or pneumococci. This last research illustrates the difficulty of growing anything at all from rheumatic material; but it is to be remarked that when anything at all was grown it was a streptococcus.

rheumatic infection" (Topley and Weir), will strike anyone who has any first-hand experience of these tests. The transference of these streptococci from their normal human habitat to the unnatural conditions of culture and inoculation seems not merely to alter their effect on living tissues, but also to make that effect changeable and uncertain. That this is in some measure due to the wide biological differences between the human habitat and that offered by the animals available for experiment, is one chief reason for the feeling that some biochemical test based on the human organism itself would be more reliable. The earliest attempt to which we have any reference was that of Tunnicliff,[51] who found a parallelism between the opsonic indices and agglutination reactions of *Micrococcus rheumaticus* and those of *Streptococcus pyogenes*. Lately Stone,[52] working in M. H. Gordon's laboratory, has attacked the problem from the angle of complement-fixation tests. He refers to papers by a number of workers who have proved the presence of complement-fixing antibodies in the blood of the subjects of various streptococcal infections; but attempts to use this phenomenon as a means of grouping streptococci have furnished conflicting results. Kinsella and Swift[53] and also Howell[54] failed to achieve by this method a grouping that was in agreement with that of any other method. Stone's own results show that the serum from *Streptococcus pyogenes* infections is poor in complement-fixing antibodies; while, on the other hand, the non-haemolytic cocci derived from cases of endocarditis lenta were rich in antibodies fixing the homologous cocci and also, though less markedly, heterologous cocci. With various strains of streptococci isolated from the tonsils of patients suffering from acute rheumatic infection he failed to effect complement fixation with the patient's own serum in nearly all his experiments. Hitchcock[55] said that he could divide the non-haemolytic streptococci into two groups by means of their complement-fixation reactions—one related to the haemolytic streptococci, the other to the pneumococci. The possibility of some sort of group-reaction or "allergy" was spoken of by Steinert[56] as an explanation of the frequency with which endocarditis lenta is engrafted on a basis of chronic cardiac rheumatism; his suggestion being that the streptococcus of rheumatic infection sensitizes the tissues to its near relative, the streptococcus of endocarditis lenta. Herry[57] and Faber[58] stated that, in the course of inoculations with rheumatic streptococci, they had proved that if the animal were first sensitized with a dose of the organisms themselves (Faber) or their endotoxins (Herry) it was much easier to provoke arthritis by subsequent inoculations with streptococci than in animals not so sensitized. Swift and Boots[59] could not confirm this, but they have found[60] that the exudate in joints inflamed as a result of serum sickness is microscopically indistinguishable from that of acute rheumatism. We have ourselves seen two cases in which serum sickness appeared to pave the way for a true rheumatic infection with polyarthritis and pancarditis. In one of these a small diplo-streptococcus was seen in the pleural exudate.

Summary.

This report concludes, from work done since 1906 (Bulloch's and Conner's reports of that date being accepted as representative), that there is no rival to the streptococcic theory of acute rheumatism. There are, however, certain difficulties about this theory.

I. While many observers have found this micro-organism, others have failed to do so.

II. Even when found the rheumatic streptococcus has been difficult to place among the streptococci.

(A) Culturally it is like *S. salivarius* and therefore like the streptococcus usually found in endocarditis lenta.

(B) The reactions excited by it in the living body present difficulties:

(1) Anatomically the lesions following experimental inoculation resemble, but also differ from, those of human rheumatism.

(2) The biochemical changes consequent on streptococcal infection are not yet understood enough to furnish a basis for grouping.

Reasons are given for thinking that these difficulties do not upset the streptococcal theory of rheumatism.

We think we have said enough to show that there remains an immense mass of work for a skilled bacteriologist to do. The difficulties are: first, that by the time a man has acquired the experience and knowledge essential to the solution of such problems as these he is already overwhelmed by routine work of all kinds; and secondly, that the necessary clinical material comes along so slowly and uncertainly as to leave great gaps in any research. What is needed is to find some bacteriologist of experience who is interested in this question of rheumatism; to provide him with such assistance as will save him from being crushed by routine; and then to arrange for the pooling of suitable material by several large hospitals. In our view this can be most satisfactorily done in London, where it would be possible for the bacteriologist himself to go from hospital to hospital and visit the patients, so that he might collect his own material and not have to rely on the variable and often imperfect technique of other men.

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[44] Ibid., xxxvii, p. 553.
[45] *Journ. Infect. Dis.*, 1912, xi, 210.
[46] *Bull. de l'Acad. Royale de Belgique*, 1914, p. 76.
[47] *Journ. Lab. and Clin. Med.*, 1918, iii, 509.
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[50] *Journ. Exper. Med.*, 1915, xxii, 615.
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[52] *Brit. Journ. Exper. Path.*, 1923, iv, 318.
[53] *Journ. Exper. Med.*, 1917, xxv, 877.
[54] *Journ. Infect. Dis.*, 1918, xx, 230.
[55] *Journ. Exper. Med.*, 1925, p. 13.
[56] *Münch. med. Woch.*, 1910, p. 1927.
[57] *Bull. de l'Acad. Royale de Belgique*, 1914, p. 76.
[58] *Journ. Exper. Med.*, 1915, xxii, 615.
[59] Ibid., 1923, xxxviii, 573.
[60] *Journ. Amer. Med. Assoc.*, 1923, lxxx, p. 12.

II. The second great objection, or group of objections, to the streptococcal hypothesis arises from the difficulty of assigning to their proper place in the family of streptococci those isolated from cases of acute rheumatism.

II. A. So far as morphology goes, it will be noted that several observers remark on the smallness of the cocci and their tendency to grow in pairs. But morphology is only an elementary means of classifying bacteria. It is not applicable to so intricate a problem as that presented by the streptococci. These must be differentiated from each other, it appears, by their behaviour; mere form and shape do not carry us deep enough. To this end classifications based on chemical behaviour in an artificial environment were proposed. Longer acquaintance with the habits of streptococci has taught us to receive these classifications with caution, or at all events to realize that the conduct of these organisms towards their chemical surroundings is not quite constant. Yet, as Andrewes[32] says, "these tests help to reveal what a recently isolated strain of streptococcus did last, and what, in the light of previous experience, it is likely to do next." Accepting these tests, therefore, as furnishing intelligible hints rather than immutable laws, we find that most bacteriologists range the streptococci isolated by them from rheumatic lesions in the same group as the *S. salivarius* or *S. viridans*. It is by reason of their action on blood-agar plates, on which they form a greenish pigment, that they receive the latter name; the former, because their capacity to ferment sugars is similar to that of the streptococci that are constant inhabitants of the normal human mouth. (Not even these delimitations, however, are strictly coterminous.) Out of this grouping has arisen one of the chief obstacles to the acceptance of the streptococcic hypothesis of acute rheumatism. Many investigators (Horder,[33] Schottmüller,[34] Libman,[35] and others) showed some years ago that it was a micro-organism of this class that is responsible for most, if not all, of the cases of that type of progressive endocarditis that has been labelled chronic ulcerative, chronic infective, subacute bacterial endocarditis, or endocarditis lenta. Not unnaturally, perhaps, some bacteriologists, linking the difficulty experienced by so many of them in recovering any bacteria from rheumatic lesions with the fact that the streptococci claimed to be associated with rheumatism were so like those of chronic ulcerative endocarditis, concluded that the cases from which these streptococci had been isolated were not really cases of rheumatism at all, but cases of chronic ulcerative endocarditis, masquerading as rheumatism. That this will not cover the facts is apparent from two considerations only among many—that streptococci have been grown from the cerebro-spinal fluid of a case of chorea subsequently recovering,[40] and from the interior of subcutaneous nodes.[21] Possibly the truth is that the same streptococcus may excite at one time an acute rheumatic pancarditis, at another a slowly progressive endocarditis, invading the whole of the cardiac tissues, by way of the coronary supply, in the one, but attacking only the endocardial surface, which it has reached from the cardiac cavities, in the other. Circumstances alter cases, and it is not difficult to conceive of a streptococcus which does no harm at all under one set of conditions, excites a "rheumatic" reaction in a second set, settles down to provoke an endocarditis lenta in a third, and perhaps is responsible for a chronic deforming arthritis in a fourth. That the streptococci supposed to cause acute rheumatism should be like those of the normal mouth appears to us to strengthen rather than to invalidate their claim, in view of the connexion of tonsillitis with rheumatism; while we believe their similarity to the micro-organisms of chronic ulcerative endocarditis is susceptible of some such explanation as we have suggested, even if the belief confessed by one of us (F. J. P.[36]) in a directly rheumatic form of ulcerative endocarditis be held to apply only to a part, and not to the whole, of the group of cases of chronic ulcerative endocarditis excited by this sort of streptococcus.

II. B. But as our interest in these streptococci is, for the purpose of this report at all events, limited to their action on the living tissues of man, so will those criteria carry most weight which most nearly approximate to the reactions of the human body. These fall into two classes: the results of inoculation into animals, and changes in the biochemistry of the human host.

II. B (1). The anatomical features of the human reaction to rheumatic infection are constant enough to justify the belief that it is a reaction excited by a "specific" infection—that is, by an infective agent of constant virulence entering the body in circumstances which do not vary greatly from case to case. The chief features of this reaction are that it begins in and around small blood vessels, and that it is formative rather than exudative. These features are very clearly seen in the tissues of the rheumatic heart, which also exhibits this characteristic, that all parts of the cardiac wall are simultaneously invaded through the coronary arteries and their branches. Now, analysis of the results of animal experiment, as recorded since 1906 by Topley and Weir,[37] Beattie,[38] Jackson,[39] Coombs, Miller, and Kettle,[40] Bracht and Wachter,[41] Thalheimer and Rothschild,[42] Rothschild and Thalheimer,[43] Swift and Boots,[44] Rosenow,[45] Herry,[46] Lintz,[47] Schloss and Foster,[48] Loeb,[49] Faber,[50] and others, shows that the structures most often attacked are the joints and the heart, as in clinical rheumatism. It is true that many of the inoculations recorded have had no tangible result; yet such results as have been seen include "lesions which together reproduce most of the features of the disease as it occurs in man" (Topley and Weir). Close scrutiny of these lesions discovers one or two important divergences from the human counterpart. In the first place, whereas the human lesions are conspicuously proliferative and importation of cells from a distance is a subsidiary feature, the experimental reactions may be so pre-eminently exudative as to be actually purulent. Yet in many instances the reaction to experimental streptococcal infection is formative, consisting of a rapid genesis of new cells, fibrous and endothelial, in the part attacked. This fact is corroborated by a study of the reactions set up in the heart and elsewhere in "endocarditis lenta." Both in the infected valve and in the embolic lesions a reaction predominantly formative may be seen. We lay stress on this because we find a widespread impression that reactions to streptococcal infection must always be suppurative or approximating thereto. This is not so either in experimental or in human infections. The greater prevalence of suppurative reactions in experimental than in human rheumatic infection is most likely a matter of dosage. The amount of streptococcus received by the inoculated rabbit must be vastly greater, in proportion to its body weight, than that which enters the rheumatic child; and moreover the rabbit receives the whole dose at once, which is not likely to be true of the infected child.

The other difference between human and experimental rheumatism is found in the type of cardiac lesion. Whereas it is in man a pancarditis implicating simultaneously the valves, muscle, and pericardium, in the experimental infection it is most often an endocarditis, of the kind that (as in ulcerative endocarditis) arises from direct implantation of the infective agent on the endothelial lining of the heart's cavity. It is true that focal myocarditis, sometimes of a kind much like that of human rheumatism, has been produced by several workers, and that pericarditis has been provoked in a few instances. But it is more usual to find the endocardial lesions overshadowing those of the rest of the heart. This kind of cardiac infection may follow inoculation with almost any streptococcus, not merely with those derived from human rheumatism. There is, therefore, some force in the objection that so far it has not been found possible to excite experimentally a pancarditis like that so characteristic of the disease seen in man. Here again, however, we must realize how widely the conditions of experimental infection differ from those of human rheumatism. It seems to us that the similarities between the human and the experimental lesions are striking enough to show that the streptococcal hypothesis is at least tenable, while the divergences are such that an explanation might be forthcoming which would not entail abandonment of that hypothesis.

II. B (2). The fact at which we have glanced above, that "similar lesions may be produced by inoculation with streptococci obtained from sources quite unconnected with

choreic types suggests (though not very clearly) that the type of tonsillitis in chorea tends to be more of the chronic or subacute variety than the acute painful type. If this is so it would tend to bring the tonsillar infection into line with the lingering choreic type of rheumatic infection and the smouldering endocarditis (mitral stenosis), with which chorea is so closely associated.

(B) *Infected Tonsillar Glands.*

St. Lawrence[12] found the tonsillar glands to be involved in 100 per cent. of cases showing tonsillar disease. Coates and Thomas[2] found these glands to be infected in 16 out of 44 rheumatic children (36 per cent.).

II.—COURSE OF TONSILLAR INFECTION IN ABSENCE OF TONSILLECTOMY.

Very little attention has been paid to the possibility of recovery in the tonsils without removal, nor does investigation along these lines reveal anything important. The fact that in quiescent stages the proportion of rheumatic children showing tonsillar disease is slightly smaller than the proportion found during active symptoms probably shows accurately enough that a small number of acutely inflamed tonsils recover. Indeed, in reviewing cases whose tonsils had shown disease during acute phases, I found two or three in whom the tonsils had apparently become normal again after the acute stages had passed; but in most cases where the tonsils appeared normal in the quiescent periods they had also appeared normal in the active stages of rheumatism.

It may be allowed, therefore, that in a few cases of acute tonsillitis the tonsils will recover completely, but such are in a minority in rheumatic cases. Once a real chronic infection of the tonsils has been established there is no evidence to show that spontaneous recovery is possible during childhood.

III.—TYPES OF RHEUMATISM IN CHILDREN WITH NORMAL TONSILS.

All authors admit that a certain small proportion of rheumatic children show no disease of the tonsils, but no one seems to have studied this small group particularly; yet it is evident that it might have an important bearing on the efficacy of tonsillectomy in rheumatism.

When, for this report, I studied the rheumatism of tonsillectomized children, I found a very high incidence of chorea in them, coupled with a very low incidence of permanent heart disease, as will be shown later. I then looked up the symptoms of those cases whom I had personally reviewed whose tonsils appeared to me to be quite normal. Of these I found only 7, but of the 7 as many as 5 had had chorea (71 per cent.), and between them they had had eight attacks of that malady. On the other hand, only one had shown any form of cardiac rheumatism, and that only transient dilatation of the heart. The full analysis of these cases is given in the Appendix.

IV.—EFFECT OF TONSILLECTOMY.

1. Immediate Effect.

(A) *Harmlessness.*

In spite of the association between active tonsillar infection and active rheumatism it has very generally been found that the removal of tonsils in the rheumatic child is rarely followed by any immediate rheumatic recrudescence. In 50 cases of tonsillectomy under my care in only one case was there any possibility of the operation having precipitated an attack—a child who developed chorea within a month of tonsillectomy. As a large number of these cases were operated on before leaving hospital—that is, within a month of admission for acute rheumatic symptoms—these results may be taken as confirming the general view that tonsillectomy is a harmless procedure in these cases.

(B) *Benefit.*

Claims have been made by a few authors, mostly specialists, that tonsillectomy has an immediately beneficial effect in some rheumatic cases. Dulaney[3] states that in 23 cases of chorea, operation gave "complete and immediate" relief which was lasting in every case for three years.

More information is required on this point. To my mind the type of case in which operation produces the most immediately favourable response is the child with protracted convalescence, where pallor, rapid heart, and swinging temperature remain; in some of this group the removal of obviously diseased tonsils will quickly usher in improvement.

2. Ultimate Effect of Tonsillectomy.

The question of the value of tonsillectomy in preventing rheumatic manifestations in children is one which has attracted many authors: unfortunately their verdicts are in wide disagreement. It will be sufficient here to quote from a few writers who have paid particular attention to this matter in England and America.

H. J. Starling,[13] in a careful study of cases of rheumatic carditis, urges operation—"the earlier the better." Hunt and Osman,[4] whose paper appears next to Starling's in the *Guy's Hospital Reports* for 1923, are unfavourably impressed: "our figures are not large enough to say definitely that tonsillectomy increases liability to rheumatic infection, but they are suggestive." Nevertheless they advise operation (though on what grounds it is difficult to appreciate from their figures), if there is definite evidence of infection in the tonsils with glandular enlargement. Poynton[8 9] regards tonsillectomy "on broad lines" as a "valuable prophylactic measure," but is against its employment as a routine in rheumatic cases.

In American literature the same disagreement is found. W. St. Lawrence[12] regards the operation as beneficial. A. D. Kaiser[6] states that tonsillectomy does not lessen the incidence of rheumatism or chorea though it diminishes the incidence of heart disease. Ingerman and Wilson[5] produce figures which are so discouraging that the authors suggest that the source of rheumatic recrudescence lies in the tracheo-bronchial glands.

These results are so contradictory that it is necessary to scrutinize the methods by which they have been obtained, and to see where the fallacy in the method adopted lies, and to evolve, if possible, a more reliable method of investigation.

(A) *Investigation by "Follow-up" Method.*

Most authors have used the method of following up for a period of years a number of rheumatic cases and seeing what has happened to them in the way of recurrences after tonsillectomy. Some have controlled these results by a further series of cases without operation. Thus:

Hunt and Osman[4]:	
All cases (144)—	
With tonsillectomy, recurrences in	53%
Without tonsillectomy, recurrences in ...	33%
After first attack (96 cases)—	
With tonsillectomy, recurrences in	46%
Without tonsillectomy, recurrences in ...	33%
After later attack (48 cases)—	
With tonsillectomy, recurrences in	75%
Without tonsillectomy, recurrences in ...	56%
Ingerman and Wilson[5]:	
All cases: Recurrences in 3 years—	
With tonsillectomy, recurrences in	76%
Without tonsillectomy, recurrences in ...	80%
Author's cases: Recurrences in 1 to 5 years—	
With tonsillectomy, recurrences in	60%

If these were all the results obtainable by the "follow-up" method of investigating the effect of tonsillectomy, it is clear that they would not be at all encouraging; but such figures as these portray only a very small part of the picture. The results of this method of investigation are contradictory and unreliable because of a lack of detail. It is unreasonable to suppose that tonsillectomy has the same possibilities for benefit in a case after repeated attacks of carditis as it may in a case taken in the prodromal stages of rheumatism. Consequently, for this method to be accurate, all cases before operation would need to be divided according to the stages of disease reached, and subdivided according to the symptoms shown, and their later recurrences again displayed in the same way. Tackled in this way this method of investigation becomes an extremely long, arduous, and complicated business. Having had it in mind for many weeks in connexion with this report it is doubtful to me if the effect of tonsillectomy is capable of statistical proof along these lines.

PART III.

REPORT ON THE EFFECT OF TONSILLECTOMY ON RHEUMATIC INFECTION IN CHILDREN.

BY

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THE association between rheumatism* and tonsillar disease has long been appreciated, and with the present improved methods for the complete removal of tonsils there has grown up the practice of removing the tonsils of all rheumatic children in whom they are diseased. The object of this report is to state whether this practice has been shown, or can be shown, to be correct, or if there are indications that it should be modified or condemned.

For this purpose I have investigated 133 rheumatic children who have been under my own care at the Paddington Green Children's Hospital in the five years preceding 1925. These cases have been taken consecutively and, as far as the 95 in-patients among them are concerned, without any selection. As regards the out-patients, numbering 38, it is evident that to some extent they are "selected," as the mere passage of time will tend to render the mildest cases untraceable through out-patient records. The cases in which tonsillectomy† had been performed were taken as they could be traced, and all those traced have been included in my figures. I have seen each one of these cases personally, and their histories before and after operation are as accurate as they can be made.

Before examining the results of tonsillectomy in the rheumatism of children it is necessary to rehearse briefly the clinical facts known of the association in them between rheumatism and tonsillar disease.

I.—ASSOCIATION BETWEEN TONSILLAR AND RHEUMATIC INFECTIONS.

1. ASSOCIATION OF "SORE THROATS" WITH RHEUMATISM.

(A) *"Sore Throat" as Prodromal Symptom.*

It is a commonplace that rheumatic children are, as a class, prone to suffer from sore throats before and between attacks. The proportion of cases complaining of this symptom is variously given by different authors.

	Sore Throats.
Ingerman and Wilson[5]: Cases showing two or more attacks of sore throat	77%
St. Lawrence[12]: Of tonsillectomy cases before operation	73%
Poynton[9]: Of 1,108 first attacks, all in-patients ...	31%
Bertram[1]: Of all cases	28%
As first symptom	5%
Author's cases (see Appendix): Of all cases ...	33%
Tonsillectomy cases only, before operation ...	51%

Poynton[9] notes that in his cases the symptom of sore throat was not so common in the choreic as in the non-choreic cases. I have examined my cases in this particular, and find the same difference, although not to such a degree as shown in Poynton's figures. It is probable that Poynton's figures refer only to sore throats ushering in chorea; my figures refer to sore throats occurring at any time in a patient who has had chorea.

Poynton (all first attacks, all in-patients):	
Of 217 choreic cases, sore throat in	4.6%
Of 891 non-choreic cases, sore throat in ...	37.0%
Author's cases:	
Of 59 cases with chorea, sore throat in ...	22.0%
Of 74 cases without chorea, sore throat in ...	42.0%

It is probable that the figures under this heading can be no more than approximately accurate. What is a "sore throat" to one hospital mother will be a "cold" to another. Few children escape nasopharyngeal infections in which the tonsils take their part. Yet even here we get a suggestion of what will be shown more clearly later—namely, that the association between tonsillar infection and chorea is less close than that between tonsillar disease and the non-choreic manifestations of the rheumatic infection.

(B) *"Sore Throat" as an Invasion Symptom.*

It is well recognized that an acute attack of rheumatic activity may immediately follow a sore throat. Such cases would be of particular importance if any attempt were to be made to select some cases of rheumatism as particularly favourable for tonsillectomy. Unfortunately it is not easy to give many figures of the proportion of attacks ushered in by sore throat.

Poynton, Paterson, and Spence[10] report that in 172 in-patients, 22 had immediately preceding tonsillitis—that is	12.8%

(C) *"Sore Throat" as a Relapse.*

It is not rare to see during convalescence from a rheumatic attack the development of a sudden but transient high fever due to fresh tonsillitis.

Author's figures[7]:	
In a series of 124 in-patients, relapses due to tonsillitis in	3.2%

(D) *Infectious Sore Throats in Rheumatic Cases.*

Raven[11] has stressed the occurrence of infectious sore throats which he has experienced in his rheumatic wards at St. Mary's Home, Broadstairs. He states that such epidemic throats will cause fresh rheumatic symptoms in some rheumatic cases, though he has never yet seen such an infectious throat set up rheumatism in a previously non-rheumatic child. Most observers will agree with these experiences.

In the interpretation of these results the question arises whether a true rheumatic tonsillitis can ever be regarded as infectious to others. It is not uncommon to find that more than one member of a family suffers from rheumatism, and it is not extremely rare to find two of a family suffering from acute symptoms at the same time; yet against the infectiousness of rheumatism, in the ordinary sense of that term, is the broad fact that the disease is never seen to spread from rheumatic to non-rheumatic in the healthy surroundings of a hospital ward (*vide* Part I).

At present, therefore, it would appear safest to interpret these observations by holding that an infectious non-rheumatic tonsillitis may light up fresh rheumatic activity in tonsils already infected with the rheumatic virus.

2. ASSOCIATION BETWEEN DISEASED TONSILS AND RHEUMATISM.

Passing from the symptom of sore throat to objective disease of the tonsils, we find complete agreement among all observers as to the particularly high frequency of tonsillar disease in rheumatic children. The question has been studied under two headings: (A) Infected Tonsils; (B) Infected Tonsillar Glands.

(A) *Infected Tonsils.*

Poynton states that tonsillectomy is required for local reasons four times as often in the rheumatic as in non-rheumatic children. Percentages of rheumatic children showing disease of the tonsils are as follows:

St. Lawrence[12]: 94 cases	82%
Author's cases:	
All cases (133) in active stages...	83%
In choreic cases only (59)	78%
In non-choreic cases only (74)	88%
In 29 cases reviewed in quiescent stage ...	73%

A comparison of these figures with those already given on the frequency of sore throats in the choreic and non-

* "Rheumatism" throughout this report means rheumatic infection, never arthritis only.

† "Tonsillectomy" throughout means the complete removal of tonsil.

already noted. I should regard the apparent increase in chorea in the tonsillectomized group as due to two causes: (1) the great diminution in non-choreic recurrences, and (2) the mere passage of time, which will operate particularly in the case of chorea, as it is usually a late rather than an early rheumatic manifestation.

To sum up: the evidence seems to point to two conclusions: (1) that chorea is not so closely associated with tonsillitis as are other rheumatic symptoms; and (2) the occurrence or recurrence of chorea is not controlled by tonsillectomy.

Speculations as to the possible explanations of these facts are beyond the scope of this report.

(*d*) *Arthritis.*—This occurred in only one case in the 27 tonsillectomized children showing active rheumatism—a proportion of 3.7 per cent. In this single case the arthritis developed five years after operation, and was accompanied by transient dilatation of the heart. The following year the same patient complained of muscular pains. Arthritis had been present in 17 out of 45 cases before tonsillectomy—a proportion of 38 per cent.

(*e*) *Heart Disease.*—The figures on this most important matter are fully analysed in the Appendix. It will be seen that in the series of 27 tonsillectomized children showing active rheumatism, of whom 18 were admitted to hospital for their recurrences, only 1 showed active heart disease during these attacks, and that only a transient dilatation of the heart; 7 others had old valvular disease apparently unaffected during the recurrence after operation. As this verdict involves a matter of personal judgement in which opinions might differ, it is perhaps safer to say that of these 27 cases with recurrences after tonsillectomy no case showed permanent heart disease which had not shown it before operation.

In order that the importance of this result may be clearly appreciated it is necessary to give the details of the condition of the heart in the cases before tonsillectomy. It has already been stated that the cases were for the most part early in type, but a fair proportion of them had had carditis of some degree.

Taking first the whole series of 133 cases, the heart showed damage in 51 (that is, 38 per cent.). The changes were: dilated heart 23, endocarditis 24, pericarditis 4. Of those affected 6 showed signs of definite heart failure; of these 2 are known to have died later.

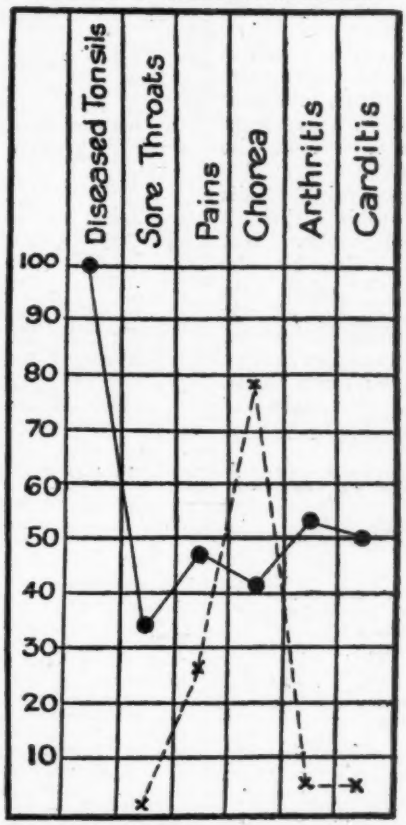
Taking the 45 cases which were submitted to tonsillectomy and afterwards traced and reviewed, the heart was regarded as having been affected before operation in 17 cases (38 per cent.). The changes here were: dilated heart 7, endocarditis 9, pericarditis 1. No case had shown definite heart failure.

These figures give as clear an idea as possible of the type of cases which are being considered here; roughly speaking, they are early cases, but by no means necessarily mild ones. The results of tonsillectomy are here eminently encouraging:* in many cases cardiac dilatation had cleared up, and in no case did permanent heart disease show itself for the first time in a rheumatic attack after operation.

(*f*) *Nodules.*—I can draw no direct conclusion on this point. Nodules were present in only 3 of the original 133 cases, and tonsillectomy was not performed in any of them. No case developed nodules after tonsillectomy.

The accompanying figure displays the distribution of symptoms in 32 rheumatic in-patients before tonsillectomy and the recurrences in the same cases after operation. The figures of both groups are given in percentages to render them comparable. In the tonsillectomized cases the number of symptoms is lessened and the preponderating symptom is that of uncomplicated chorea.

ANALYSIS OF RHEUMATIC SYMPTOMS.



Symptoms per 100 rheumatic in-patients.
———. Children with diseased tonsils.
× - - - - × Tonsillectomized children.

CONCLUSIONS.

1. METHODS OF INVESTIGATION.

The effect of tonsillectomy on the rheumatic infection of childhood has up to the present been mainly investigated by the use of a "follow-up" method. The results thus obtained have as yet proved very contradictory, and no judgement on the effect of the operation can be formed on them. This method might succeed in solving the problem, but only after very arduous and prolonged investigations involving the study of cases in far greater detail than has yet been attempted. Indeed, in the case of a disease with so complicated a symptomatology as rheumatism, in which recurrences are so frequent and the symptoms of each "attack" so numerous, it is doubtful whether the "follow-up" method is capable of producing statistical proof of the value or uselessness of tonsillectomy.

A method of investigation which is far more applicable to the problem is the close study of the rheumatic infection as it occurs in children whose tonsils have been completely removed. If, after examining a large number of cases of rheumatism in tonsillectomized children, the infection shows signs of having been modified as compared with the rheumatism of children with diseased tonsils, conclusions as to the effect of the operation may legitimately be drawn. Further investigations on these lines are needed.

2. RESULTS OF PRESENT INVESTIGATION.

For this report the rheumatic symptoms occurring in 45 tonsillectomized children over periods of one to five years have been subjected to analysis. These have been compared with the symptoms in the same children before operation and controlled by an analysis of the symptoms of 133 children with tonsils.

Analysis of these cases produces evidence strongly in favour of the value of tonsillectomy. Sore throats, arthritis, and carditis in all its forms, are found to be greatly diminished in the tonsillectomized cases. Muscular pains remain frequent, though largely uncomplicated by more serious symptoms and tending to disappear gradually after operation. Chorea, on the other hand, appears to be totally uncontrolled by previous tonsillectomy; the great majority of first and later in-patient attacks of rheumatism occurring in tonsillectomized children consist of chorea, usually uncomplicated.

Before these results can be accepted two provisos must be noted:

(1) The number of cases is small (45).
(2) The cases submitted to tonsillectomy and reviewed later were for the most part early, though not necessarily mild, cases (see Appendix).

3. SELECTION OF CASES SUITABLE FOR TONSILLECTOMY.

Although it is shown above that chorea readily occurs in tonsillectomized children, yet if it is true, as my figures suggest, that previous operation tends to prevent the heart from being affected, it would seem that even in chorea tonsillectomy is of value.

Again, on theoretical grounds it is impossible not to suppose that early cases are more favourable for tonsillectomy than are later ones. Hunt and Osman[4]

* A. P. Thomson, writing to me after this report was drawn up, tells me that his figures strongly confirm this conclusion.

To sum up: the "follow-up" method of investigating the effect of tonsillectomy in rheumatism cannot at the present time be held to have demonstrated any definite conclusion for or against the operation.

(B) *Investigation by the Study of Rheumatism in Tonsillectomized Rheumatic Children.*

There is another method of investigating the effect of tonsillectomy—that of studying the manifestations of rheumatism in tonsillectomized children. This promises results with far less labour than the "follow-up" method, and plenty of material ought by now to be available. It is clear that if, in sufficient cases, the rheumatism of tonsillectomized children is found to be of a modified type, conclusions can be drawn as to the value of the operation.

For this report the rheumatic manifestations found in 27 children whose tonsils had been previously removed have been studied. These are fully analysed in the Appendix, and the conclusions which this analysis demonstrates will here be given.

(1) *First Attacks in Tonsillectomized Children.*

Many authors have noted, what is undoubtedly true, that tonsillectomy will not always prevent a child from having a severe attack of rheumatism. It would be interesting to know how many such were first attacks, but I can find no figures on this point.

In my own cases 7 children had had no more than tonsillitis or tonsillitis and pains before operation, who later had to be admitted for the first time to hospital for rheumatism. It is noteworthy that of these 7, no fewer than 5 developed chorea only. The sixth case had arthritis and dilated heart, and the seventh had generalized muscular pains with fever but without heart lesion. (This case is of particular interest to me as it was the first case which suggested to my mind the possible modifying influence of previous tonsillectomy.)

These figures suggest that where a child does not suffer from severe (that is, in-patient) rheumatism until after tonsillectomy, it is far more likely to develop chorea than any other manifestation.

(2) *Recurrences in Tonsillectomized Children.*

Before examining the rheumatic symptoms in these children a word must be said on the material used.

I have already stated that all the 45 cases studied before and after tonsillectomy have been reviewed by me personally and were taken consecutively as they could be traced. But it is here proper to say that, taken as a whole, they were early cases. Although a large number of them had had cardiac rheumatism of some degree before operation, none was of the type of chronic cardiac cripple, likely to die in a year or so. It would be fair to say that every case was a rheumatic rather than a cardiac problem.

Of these 45 cases, 27 showed recurrences in the five years under review—a proportion of 60 per cent. I have already mentioned that this proportion must be regarded as slightly raised artificially.

It is necessary to go through the symptoms of rheumatism seriatim in order to display the modification of the infection by previous tonsillectomy.

(*a*) *Sore Throat.*—In no case after complete tonsillectomy was there any further complaint of sore throat, although before operation this symptom was present in 56 per cent. of the cases. This is obviously too good to be true. St. Lawrence, comparing cases before and after tonsillectomy, gives the percentages of sore throats as 73 and 7 respectively. Similarly, he gives the proportions showing palpable tonsillar glands as 100 per cent. before and 41 per cent. after operation.

Probably it needs no statistics to prove that children without tonsils suffer less from sore throats than children with diseased tonsils, but in connexion with the rheumatic infection the following points may be noted:

i. A great drop in the number of sore throats can hardly be regarded as other than favourable to the future of the rheumatic child.

ii. Cases of incomplete tonsillectomy do not enjoy the same degree of immunity from sore throats as those of complete enucleation.

iii. The removal of tonsils and adenoids will not always be the only measure necessary to produce freedom from chronic nasopharyngeal infection.

iv. Complete immunity to rheumatism would not necessarily follow the most absolute immunity to sore throats even theoretically, as some few cases of rheumatism show no tonsillar symptoms.

(*b*) *Pains.*—In common with the results of other observers my own tonsillectomized cases showed recurrence of muscular pains in many instances—11 out of 27, or 41 per cent. These for the most part recurred within a year or so of operation and then ceased. The important fact in this connexion is the lack of complications of severity accompanying the pains. In only three instances did the pains lead to in-patient treatment: one because of the presence of old valvular disease; one because of the presence of acute appendicitis; and one, already mentioned, because of the presence of fever, although the heart remained unaffected.

(*c*) *Chorea.*—As my results under this heading are remarkable and have not been stressed by others, I may venture to state that they were not anticipated by me. I had observed that cases of chorea without any other accompanying rheumatic symptoms seemed to be getting more common than formerly, but I had not recognized that many such were examples of chorea in tonsillectomized children.

Directly I began to summarize the rheumatism of tonsillectomized children the frequency of chorea in them became obvious. This can be shown in various ways:

i. The frequency of chorea as the first serious rheumatic symptom in tonsillectomized children (vide supra).

ii. In 27 cases of post-tonsillectomy rheumatism, 17 (63 per cent.) showed chorea; these 17 cases showed 21 attacks of chorea between them.

iii. Taking in-patients only, 18 were admitted for rheumatism after operation; of these, 14 patients (78 per cent.) showed chorea.

iv. Taking the same 45 cases submitted to tonsillectomy, chorea was present before operation in 29 per cent., or, considering in-patients only, in 41 per cent.

In this series of cases, then, the proportion showing chorea is vastly higher after tonsillectomy than before. This is so striking that one looks for any confirmatory evidence elsewhere.

i. Poynton, Paterson, and Spence[10] report recurrences in 17 in-patients after tonsillectomy. In at least 13 of them chorea was present—a proportion of 76 per cent. as compared with 78 per cent. in my series.

ii. A. P. Thomson tells me that of 16 tonsillectomized children admitted under his care for rheumatic manifestations, 10 (=62.5 per cent.) showed chorea only; of these, 4 had had repeated attacks since their tonsillectomy.

iii. It has already been pointed out that in the 7 cases of the present series whose tonsils were apparently quite healthy, 5 suffered from chorea—a proportion of 71 per cent.

Thus there appears to be some confirmatory evidence for the conclusion reached above—namely, that chorea is the commonest serious rheumatic manifestation in tonsillectomized children.

If this is granted, a question of interest arises: Is the increase in choreic cases observed after tonsillectomy an apparent or real increase—that is to say, does the frequency of chorea in these cases stand out merely because all other serious types of rheumatism are greatly diminished in them, or are the choreic cases really increased by the operation?

The percentage of choreic cases after tonsillectomy is greatly increased, as has been shown, but if we examine the actual numbers the increase is comparatively small, as is shown in the following table:

	Before Tonsillectomy.	After Tonsillectomy.
With chorea	13	17
Without chorea	32	10
No symptoms	0	18

The actual increase in chorea is thus seen to be very much less than the increase proportionate to other rheumatic symptoms after tonsillectomy.

To my mind there is no evidence that tonsillectomy increases the liability to chorea; in only one case did chorea develop within a month of operation, as has been

PART IV.

REPORT ON THE ORGANIZED AFTER-CARE OF RHEUMATIC CHILDREN IN GREAT BRITAIN.

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At an early stage in this investigation it seemed obvious that information derived from material already in print would be very incomplete and was likely to prove useless for the first purpose aimed at.

With the object of covering the whole of Great Britain it was decided to address a special questionary to the school medical officers in all the areas under the Board of Education. In all, 356 letters were sent out—320 to Education Committees in England and Wales, and 36 to Education Authorities in Scotland. Subsequently a letter was addressed to those who did not answer the first inquiry, and ultimately 272 replies were received—242 from England and Wales, or 75 per cent., and 30 from Scotland, or 83 per cent. The information asked was: the number of the school population; the percentage found to be suffering from rheumatic or cardiac disease; and if there were any special clinics or special schools to which children suffering from rheumatism or cardiac disease were being sent.

The replies received, however, were not sufficiently complete or uniform for the purpose of a statistical report.* In a number of cases the annual report of the school medical officer was enclosed; in others the statements were quite general. Other sources of information were *The Health of the School Child* (Annual Report of the Chief Medical Officer, Board of Education for England and Wales) for the years 1921-24 inclusive; Annual Report of the Invalid Children's Aid Association, London, and the Liverpool Child Welfare Association. These were supplemented by the official list of certified special schools published by the Board of Education (List 42).

Opportunity should be taken at this point to acknowledge the courtesy of those school medical officers who took great pains to supply me with detailed statistics.

I have also had the opportunity of personally inspecting five of the special residential schools for rheumatic cardiac children—namely, the Baskerville Home, outside Birmingham, with which Dr. Thomson is specially associated; the portion set apart in St. Mary's Home, Broadstairs, under the direction of Dr. M. O. Raven; the Edgar Lee Home at Willesden and the Kurandai Home at Hartfield in Sussex, both run by the Invalid Children's Aid Association, under the medical supervision of visiting physicians from the London area; and the Biggart Memorial Home at Prestwick, Scotland.

The list of replies received from school medical officers has been arbitrarily divided into two groups. The first group contains those areas in which the percentage of children examined who were found to be suffering from organic heart disease was 0.5 or over. The second group contains those areas in which the percentage was found to be less than 0.5, or from which sufficient information was not received. Out of the 272 replies received, 102 fall into the first group, and 170 into the second group.

Any classification of this kind must be very unreliable, owing to the large number of school medical officers on the results of whose examinations the figures are based. The distinction between organic heart disease and functional disorders is, in many cases, difficult even for the specially trained man, and without some clearly defined scheme of classification the figures must vary with individual opinion. Apropos of this point, in the Annual Report of the School Medical Officer of the City of Birmingham Education Committee for 1924, one of the assistants is noted as having carried out an investigation into the present condition of the hearts of 90 children who were noted at some previous period as having shown abnormal heart conditions. Of 80 who presented abnormal sounds, in only 27 had they persisted, while in 53 they had disappeared. Of 7 who showed enlargement of the heart alone, in none had the condition persisted, and in 3 who showed tachycardia alone there was still some acceleration of the heart rate. The period of time covered by the examinations ranged from two to seven years, the majority being from three to five years.

A further difficulty arises with regard to accepting figures from the various Education Committees, as a number of the bad cases of cardiac rheumatism, or of rheumatic fever, or chorea, are not attending school because of those conditions, and only in some areas is the school medical officer in possession of information as to the cause of the absence from school. In the London County Council area Dr. (now Sir William) Hamer investigated this question and makes the following remark in his letter:

> "Records of children absent from school for more than three months show that of these cases 23.9 per cent. were absent on account of rheumatism, heart defects, or chorea, and here again the incidence among girls is considerably higher than among boys —27.3 per cent. as against 19.4 per cent."

It is interesting to note that in 1919 the percentage of those absent was 14.4, and it had risen to 23.5 in 1922. He attributes this to the prevalence of scarlet fever.

In a number of the school areas no special effort has been made to determine whether or not certain cardiac conditions found were associated with previous rheumatism, and, as rheumatism is not a scheduled disease on the list of defects issued by the chief medical officer of the Board of Education, the incidence of rheumatism among the school population cannot be ascertained. In a few areas, however, special investigations have been carried out. In Lancashire, in 1919, it was found that 29 per cent. of 1,211 children examined in the Wigan district had signs of rheumatic infection, the percentage being higher among those living in low-lying parts and upon clay soil. At Crewe, in 1924, 2.5 per cent. of entrants, 5.6 per cent. of intermediate children, and 15 per cent. of leavers were found to be suffering from rheumatism. In Cheshire County 10 per cent. of the elementary school children showed signs of early manifestations of rheumatism. In Rhondda, in 1923, 15.8 per cent. suffered from rheumatic disorders.

Methods Adopted.

In most of the areas cases when discovered at the routine examination are referred to the ordinary school clinics, which are in operation in practically all areas, or to their private doctor. Special cardiac clinics hardly exist. In a few areas, however, no attempt is made to deal with these cases at all. This is contrary to general practice and to the recommendation of the chief medical officer of the Board of Education.

* A tabulated statement of the replies may be received by application to the Medical Secretary of the Association.

show that recurrences are less common in cases operated on after a first attack than in those in whom the operation has been delayed until later. Probably still more favourable would be the group operated on in the prodromal stages, before an acute rheumatic attack has declared itself. To my mind the early operation is probably one of the many factors making severe rheumatism rare in private practice as opposed to hospital practice.

One other group of cases requires special mention—namely, the type in which there have been repeated attacks of carditis and there is already a prospect of a fatal ending at no distant date. The series of cases here analysed contained no instances of this type, and no opinion is expressed as to the wisdom of exercising a selective choice of cases for operation in this group. My own practice is to proceed to tonsillectomy as soon as the condition of the heart permits of the operation, but this is based only on theoretical considerations. Starling's paper,[13] which deals only with cases of heart disease, not confined to children, gives encouragement to this line of treatment and states that no case has been harmed by the operation: with these views I personally agree, but for this report, having offered no evidence dealing with cases of advanced heart disease, I prefer to express no opinion and to exclude these cases from the conclusions expressed above.

The question of the advisability of the removal of tonsils in rheumatic children as a routine measure is a difficult one, and is not always an entirely medical problem. Not only must the cases be considered individually, but the facilities for expert operation must also be taken into account. The type of case here reported on has already been described. Every tonsillectomy was done at hospital by a throat specialist. Many of the cases were operated on as out-patients and were not admitted even for a night. Others were in-patients recovering from acute attacks and operated on before their discharge. A few were admitted for special reasons for the operation. The results, both immediate and ultimate, were, as has been shown, favourable.

The value of the routine removal of tonsils in rheumatic children depends on many factors, and it is the intention of this report to leave this question open, merely giving the results which have been obtained in described cases operated on under specified conditions.

In conclusion it is well to emphasize the fact that in removing diseased tonsils in rheumatic children one is at most dealing with only one factor predisposing towards the disease. While powerful environmental causes remain unaltered, all figures in favour of the value of tonsillectomy will necessarily be diluted by many unsuccessful results.

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APPENDIX TO PART III.

ANALYSIS OF AUTHOR'S CASES.

Total number of cases, 133.

Boys ... 56	In-patients ... 95	With chorea ... 59	
Girls ... 77	Out-patients ... 38	Without chorea ... 74	

Percentage of "Sore Throats."

All cases (133)	33%
Cases with chorea (59)	22%
Cases without chorea (74)	42%
Tonsillectomy cases only, before operation (45) ...	51%

Percentage showing Diseased Tonsils.

All cases (133)	83%
Cases reviewed in quiescent stages (29)	73%
Cases with chorea (59)	78%
Cases without chorea (74)	88%

Rheumatic Symptoms in Cases with Normal Tonsils.

Seven cases showed on review normal tonsils; of these, 2 had previously shown tonsillar enlargement. All were girls.

Cases showing chorea (5)	71%
Cases showing temporary dilatation of heart (1) ...	14%
Cases showing permanent heart disease	0%
Number of "attacks" in these 7 cases	12
Number of attacks of chorea	8

For other symptoms, see table below.

TONSILLECTOMY CASES.

Number of cases submitted to tonsillectomy, 50.

Cases showing gross tonsillar remnants ...	3	
Cases showing presence of adenoids ...	2	
	—	5
Cases used for analysis		45

Analysis of 45 Cases of Tonsillectomy.

Total number of cases, 45.
Boys, 23. In-patients before operation, 32; after, 18
Girls, 22. Out-patients before operation, 13; after, 9

Recurrences after Tonsillectomy.

Total number of cases traced for 1 to 5 years ...	45
Cases showing no recurrence (18)	40%
Cases showing recurrences (27)	60%

Chief Rheumatic Symptoms before Tonsillectomy.

	All cases (45).		In-patients only (32).
Arthritis	17 = 38%	.....	17 = 53%
Chorea	13 = 29%	.....	13 = 41%
Heart affections ...	17 = 38%	.....	16 = 50%

Chief Rheumatic Symptoms in Tonsillectomized Cases.

	All cases (27).		In-patients only (18).
Arthritis	1 = 4%	.....	1 = 5.5%
Chorea	17 = 63%	.....	14 = 78%
Heart affections ...	1 = 4%	.....	1 = 5.5%

ANALYSIS OF SYMPTOMS IN ALL GROUPS.

The accompanying table shows the symptoms in the groups of cases which have been studied in this report. The groups are as follows:

I. All cases (133 in number).
II. Reviewed cases with normal tonsils (7).
III. Tonsillectomy cases before operation (45).
IV. Tonsillectomy cases—recurrences after operation (27).
V. Tonsillectomy cases—in-patients only; before operation (32).
VI. Tonsillectomy cases—in-patients only; recurrences (18).

	I.		II.		III.		IV.		V.		VI.	
	A	B.	A.	B.	A.	B.	A.	B.	A.	B.	A.	B.
Diseased tonsils ...	111	83	—	—	45	100	—	—	32	100	—	—
Sore throats	44	33	2	28	23	51	0	0	11	34	0	0
Pains	54	41	3	43	22	49	11	41	15	47	3	17
Chorea	59	44	5	71	13	29	17	63	13	41	14	78
Arthritis	44	33	3	43	17	38	1	4	17	53	1	5
Dilated heart ...	23	17	1	14	7	16	1	4	7	22	1	5
Endocarditis ...	24	18	0	0	9	20	0	0	8	25	0	0
Pericarditis	4	3	0	0	1	2	0	0	1	3	0	0
Total cardiac ...	51	38	1	14	17	38	1	4	16	50	1	5
Nodules	4	3	0	0	0	0	0	0	0	0	0	0

A=Actual figures. B=Proportions per 100 cases.

NOTE.

The above figures represent symptoms per patient and not per "attack." Thus:

1. A case might have more than one attack of a certain symptom—for example, chorea—but such would figure as only 1 under the heading of chorea.
2. The heart affection of any one case appears under only one of the three headings used above—for example, a case showing pericarditis would be entered under that heading only, although endocarditis was also present. Under "dilated heart" are numbered the cases in which the heart affection was judged to be of a temporary nature only.

My thanks are due to my clinical assistant, Dr. Mary Davies, for her help in collecting and analysing the figures for this report.

The results have justified the plan, and a more permanent home is at present being sought. During the first year 123 cases were admitted for periods varying from one to twelve months (average five months), and only 2 cases had rheumatic relapses. There is a medical officer (Dr. Prince) in the village, and a consulting staff of London physicians. The average total cost of each patient per week is £1 1s. 3½d.

St. Mary's Home, Broadstairs. The Horsfall Hospital wards in St. Mary's Home have been set aside for the treatment of rheumatism, carditis, and chorea, under the care of Dr. M. O. Raven. During three and a half years 92 cases were admitted. Since October, 1925, education has been given by a fully certificated mistress. The average residence is about ten months. Out of 75 patients discharged, 6 had died, being severe and advancing cases of cardiac rheumatism. Of the remainder, 46 were re-examined: 31 had had no relapses, while 15 had shown active rheumatism, chorea, or carditis. Dr. Raven considers that the longer the stay the better is the progress, and that tonsillectomy is an important factor in controlling the recurrence of acute rheumatism and rheumatic pains; it is less effective in chorea.

Invalid Children's Aid Association (London). In the annual report for 1924 it is noted that there were dealt with: new cases of heart disease, 601; of chorea, 567; of rheumatism, 364, included in which will be those children sent to the two homes above mentioned. Others were sent to convalescent homes or were visited and advised.

Areas in which Special Arrangements have been Intimated.

Birmingham.—Special attention is given to rheumatic, cardiac, and choreic children by the Education Committee. The Society for the Care of Invalid Children assists by sending about 50 children away yearly for long periods to convalescent homes. Baskerville Residential School (*q.v.*) is almost entirely devoted to this class of case. There are also day schools for physically defective children, in which 86 children with heart disease are educated. In the report for 1924 the result of the after-history of 100 choreic children is given. Of 36 well marked cases, 19 were in a very unsatisfactory state; of these 19, 13 had been treated at home, 2 had been taken home before recovery, and 4 were in hospital. Of 13 who were making progress, 2 were at Baskerville, 5 in country hospitals, and 6 at home making slow progress, and 4 others were cured. Of 64 cases of minor chorea, 25 were in an unsatisfactory state, and of these 24 were being treated at home; one improved after three months in the country; 28 were making progress, 8 in the country, 5 at Baskerville, and one was sent into the country by the parents, while 14 were at home. Dr. Burt, who made the inquiry, remarks that these children do best when treated on sanatorium lines—kept resting in bed in open-air shelters until the movements have subsided. Home treatment seems to be unsatisfactory.

Bristol.—Special interest is taken in heart disease in childhood in this area by Dr. Askins, the school medical officer, in co-operation with Dr. Carey Coombs and Dr. Herapath. The school medical officer states that the two great difficulties are: (1) ignorance in regard to the disease, and (2) lack of facilities for treatment. As a starting-point in combating the first difficulty, the Bristol Education Committee has issued the following circular (based on one issued by Dr. F. J. Poynton) to all head teachers:

Heart Disease in Childhood.

1. Heart disease is one of the greatest causes of death and invalidity at the present day. Last year 59,800 people died of this ailment in England and Wales—that is to say, one death in every eight was due to heart disease.

2. Many cases of heart disease commence in childhood and are frequently unnoticed at their onset. If cases are treated properly in the earlier stages a cure can usually be effected, but once the heart is seriously damaged complete recovery is impossible.

3. The most frequent cause of heart disease in childhood is rheumatism. Rheumatism is due to an organism which is liable to attack the heart and cause heart disease. In addition, this organism is the cause of chorea (or St. Vitus's dance), which is simply rheumatism of the brain. It may also be the cause of chronic sore throats. This rheumatism is frequently quite mild in character in children, so mild that parents may call it "growing pains."

4. Rheumatic heart disease is often painless and requires a doctor's examination for its detection. Shortness of breath, loss of flesh, and pallor, are early signs that this organ is affected.

5. Pains in muscles and joints should receive immediate attention as being possibly the onset of rheumatism, which may be followed by heart disease or chorea. Rheumatism frequently occurs, especially in spring and autumn.

6. Great nervousness, dreaming at school work, alteration in disposition, and slight twitchings, are often evident before chorea begins, and are most important warnings.

7. When injured by rheumatism or chorea, the heart recovers slowly from the poisoning, and one of the greatest dangers to the child's future is for it to resume ordinary life before the heart is cured.

8. Three things are specially necessary to combat the present loss of life and efficiency caused by heart disease:

(1) *Education of the public* in regard to heart disease in childhood.

(2) *Prolonged treatment* in the early stage of cases where the heart has become affected. This must be under close medical supervision, and in the case of poorer children can only be obtained in hospitals which are able to keep cases for a lengthened period. Such treatment should extend over some months. The first exercise taken must be carefully watched and graded.

(3) *Choice of occupation* for a child who has suffered from heart disease in school is most important. Very many lives are wasted through such children taking up the wrong career.

Carlisle.—In 1924 ten children suffering from chorea or rheumatic heart disease were in attendance at the open-air class for periods varying from five to fifty-six weeks. Three who had attended for over forty weeks were sufficiently improved to be returned to the ordinary school; five whose attendance had been from ten to forty weeks had improved but were still attending the open-air class; of two who had only been five and six weeks respectively in attendance, both showed some improvement and are still attending.

Dundee.—Eleven cases are treated in a special school, and they are induced to stay until the age of 16.

Edinburgh.—In the city of Edinburgh there are 27 cases of heart disease in special schools; these are mostly day schools.

Glasgow.—A number of cases of rheumatic heart disease and chorea are treated at special schools or classes for physically defective children, the numbers dealt with being 7 cases of rheumatism, 52 of heart disease, and 9 of chorea; 55 heart cases attend school clinics. A number of these cases are dealt with at the residential hospital school at Biggart Memorial Home, Prestwick, but there is no special accommodation reserved for this class of case. A special cardiac clinic is held at the Royal Hospital for Sick Children, and cases are also dealt with at the country branch of the Royal Hospital for Sick Children at Drumchapel, where residence can be prolonged.

Halifax.—In five years, four cases of organic heart disease have been in residence at the Bermerside Residential Open-Air School. Results were in every case satisfactory. The school has accommodation for 150 children.

Leeds.—Several patients are sent to schools for crippled children. Special lists are kept and the children are re-examined. An After-Care Committee keeps in touch after school age with cases who have been in cripple schools. An interesting analysis is given, showing the age at onset of 176 cases of rheumatism found at the age of 12, representing 2.8 per cent. of those examined. The following figures give the percentage which began in each year from the first to the thirteenth—namely:

First, 0.0; second, 0.02; third, 0.1; fourth, 0.2; fifth, 0.2; sixth, 0.2; seventh, 0.1; eighth, 0.1; ninth, 0.2; tenth, 0.3; eleventh, 0.4; twelfth, 0.7; thirteenth, 0.4=2.92.

City of Leicester.—Considerable attention has been given to the subject of rheumatism and heart disease in this area by Dr. Warner, who makes a special report on the condition, as a result of which two special classes for the education of these children have been started. The children are treated as in an ordinary open-air school, having a good meal at school and reclining for an hour thereafter.

Lindsey, Lincolnshire.—Children are sent to the Louth open-air school, where there is accommodation for 30 boys and girls. Eight rheumatic cardiac cases are in attendance at this school, four of which showed definite improvement, one showed no improvement, two have been absent too much to have received benefit, and one was withdrawn. Some children are also sent to the residential school at West Kirby, but it is not stated whether any rheumatic cases are so dealt with.

Liverpool.—There are not any special schools or homes for rheumatic or cardiac cases, though the education authority sends some of the children to residential schools for physically defective children. There is a heart clinic at the Liverpool Royal Infirmary; this, however, is not in direct connexion with the residential school for physically defective children. Children are usually sent to the clinic for advice regarding treatment. The Royal Liverpool Children's Hospital has a country open-air hospital at Heswall, where one chief branch deals with rheumatic children and provides a prolonged stay in hospital, though there are also cases of surgical tuberculosis in the same block. The Liverpool Children's Welfare Association pays sums of from 12s. 6d. to 5s. a week for the maintenance of children with heart troubles, chorea, or early rheumatism, at Heswall, and in the open-air wards of the West Kirby

Special Schools.

In a minority of the areas children who are the subjects of rheumatism, cardiac disease, or chorea, when sufficiently well are sent to certified special schools, where they are taught along with cripples and children too delicate to bear the stress of ordinary school life. Out of the 242 areas from which information was received, 42 noted that they made use of these facilities. In very few instances are the rheumatic and cardiac cases specially segregated. In another small proportion of cases these children are looked after in special open-air classes attached to the ordinary schools.

Open-air education is carried out in several areas. In Leicester there is a playground class; in Nottingham public parks and open spaces are used; in London thirty-three classes are held in parks, open spaces, squares, or gardens, and sixty-two classes in playgrounds.

Open-air day schools have been established in London, Bradford, Birmingham, Liverpool, Bristol, Newcastle-on-Tyne, Darlington, and elsewhere. Sir George Newman draws attention to the fact that rheumatic children, including those suffering from chorea, do not as a rule do well at an open-air school. This is entirely contrary to the experience at Kurandai in Hartfield, Sussex, where the children were treated during the whole of a wet winter (1924-25) in the open air, and not until the last fortnight of the year's residence was there a single relapse of a rheumatic nature.

Schools for Children after Rheumatism.

According to the Board of Education (List 42 of Special Schools) there are three classes of schools to which children suffering from the after-effects of rheumatism may be admitted—namely, open-air schools, cripple schools, and hospital schools. These constitute three of the five groups of special schools set apart for physically defective children, and in each group there are day schools and residential schools.

Open-air schools are for "delicate and debilitated children suffering from non-infectious conditions." Some provide medical treatment and care.

Cripple schools are for "children suffering from crippling defects or weak hearts." No treatment other than exercises is provided.

Hospital schools are "for education, and treatment of non-pulmonary tuberculosis and other crippling defects."

In England and Wales, out of a total of 360 day and 60 residential special schools provided by the Board of Education, and 1 day and 123 residential schools (voluntary), there are thus available for cardiac and rheumatic cases, in association with other delicate and crippled children, the following schools:

	Provided.		Voluntary.	
	Day.	Residential.	Day.	Residential.
Open air	45	13	1	11
Cripple	60	1	0	12
Hospital	1	5	0	35
Total	106	19	1	58

—the accommodation provided for in these schools being in the day schools 9,854, and in the residential schools 5,339. It must be clearly understood that this accommodation is used much more for crippled, anaemic, pre-tuberculous, or other invalid children, and only in a very few cases does rheumatism or cardiac disease receive any special consideration.

In view of the fact that the question of expense would naturally arise in connexion with any schools for the special segregation of these cases, it is interesting to note that in council schools the average annual cost per head for day and residential schools was: in open-air schools £26 and £67 respectively; in the cripple schools £41 and £79 respectively; and for the residential hospital schools £78. In the residential voluntary schools the cost was: open-air schools £74; cripple schools £78; and hospital schools £113.

Education in Special Hospitals.

With regard to the education of children in special hospitals it is in the power of the Board of Education to certify such hospital as a special school for physically defective children under the Education Act. If the children are sent by the local education authority the managers of the hospital may make to the authority a weekly charge for the maintenance, treatment, and education of the child, and the Board may pay at the rate of 50 per cent. of the authority's net expenditure. In the case of children sent by boards of guardians, voluntary associations, or private persons, the Board of Education may make grants to the managers not exceeding £24 10s. for each unit of average attendance. This grant is supplementary to the fees paid by the body responsible for the children.

Following up: Delicate Children.

A considerable amount of following up and treatment of delicate children is undertaken by more or less voluntary Children's Care Committees throughout the country. The chief medical officer reports that Children's Care Committees are in operation in London, Birmingham, South Shields, Somerset, Surrey, Essex, and Herefordshire, and that other organizations which do similar work are the National Society for the Prevention of Cruelty to Children, the Invalid Children's Aid Association, and the Children's Country Holiday Funds.

In the *Lancet* of January 16th, 1926, attention is drawn to the report on rheumatism in childhood submitted to the Metropolitan Asylums Board by Dr. W. T. Gordon Pugh. Dr. Pugh gathers, after an interview with the officials of the Ministry of Health, that it is unlikely that any objections would be raised to the admission of such patients to the Board hospitals in the same way as other fever cases. After consideration of his report, the Metropolitan Asylums Board adopted his suggestion that accommodation for rheumatic children should be provided at Queen Mary's Hospital for Children, Carshalton, Surrey. Application for sanction to this proposal will be made to the Ministry of Health.

SPECIAL RESIDENTIAL HOSPITAL SCHOOLS FOR RHEUMATIC, CARDIAC, AND CHOREIC CHILDREN.

Baskerville Home, near Birmingham, is scheduled as a residential school for cripples; it has accommodation at present for 47 girls, and an addition to the premises now nearing completion will increase accommodation to 90 places for boys and girls. It is practically reserved for rheumatic, cardiac, and choreic cases. Suitable children may be kept for a year or longer, and school life may be prolonged until the age of 16, as against the age of 14 in ordinary schools. The medical care of the children is ensured by a doctor who lives in proximity to the school, and a consultant from Birmingham who visits at regular intervals, in addition to the daily supervision by the matron and nurses. Children receive education adapted to their physical ability from teachers sent by the local education authority. Children who are unable to sit or stand may receive instruction while in the recumbent posture in specially arranged couch rests. There are facilities for holding classes in the grounds when the weather is suitable. Dr. Thomson reports on the cases of 50 children who had lived at Baskerville for over a year. Six were believed to have done well but were not personally seen by him; of the remaining 44, 3 died, 7 relapsed, and 5 showed deterioration; the remaining 29 did well, continuing regularly at the ordinary school, or at work, and their heart disease either remained stationary or improved. During the period covered very severe cases of heart disease were admitted and kept for short periods only—that is, less than six months, which he now regards as a minimum.

Edgar Lee Home, Willesden, is scheduled as a residential open-air school, and is under the management of the Invalid Children's Aid Association (London). It has accommodation for 22 boys. There is a local medical officer, and consulting physicians visit from London. The average period of residence is 119 days, and the cost of each patient per week is £1 8s. 0½d. The boys live indoors, but are taught in the open air. Since 1918, 327 cases have been treated with encouraging results. The boys have simple games and a modified school curriculum.

Kurandai Home School of Recovery, Hartfield, Sussex, is scheduled as an open-air school, and is under the management of the Invalid Children's Aid Association (London). It has accommodation for 50 girls and small boys. The children are housed in open-air shelters during summer and winter. This place was opened as an experiment and as a temporary home,